



Ultra-small Nanohybrides for Advanced Theranostics

Antitumor activity of carbon dots with different chemical compositions

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Nanoparticles against cancer

PROS

Drug carriers

- Deep tissue penetration
- Passive and active specificity to tumor cells/tumor microenvironment
- MDR overcoming
- Drug stabilizers
- Shields for normal cells

Drugs itself

- Remote activation (RF, MF, MW, PT, US)
- Cryosurgery

Imaging

CONS

- Lack of routes of administration
- Difficulty of degrading
- Toxicity
- Mononuclear phagocytic system
- Technological challenges



Aim

- ▶ to evaluate potential anticancer activity of carbon dots(CDs) with different chemical composition after repeated administration to C57BL6 mice.

Namely :

- to assess the mice survival and wellbeing;
- to evaluate tumor size dynamics during the treatment;
- to estimate body weight changes;
- to check the internal organs for the presence of metastases;
- to analyse serum biochemical parameters;
- to analyse hematological parameters



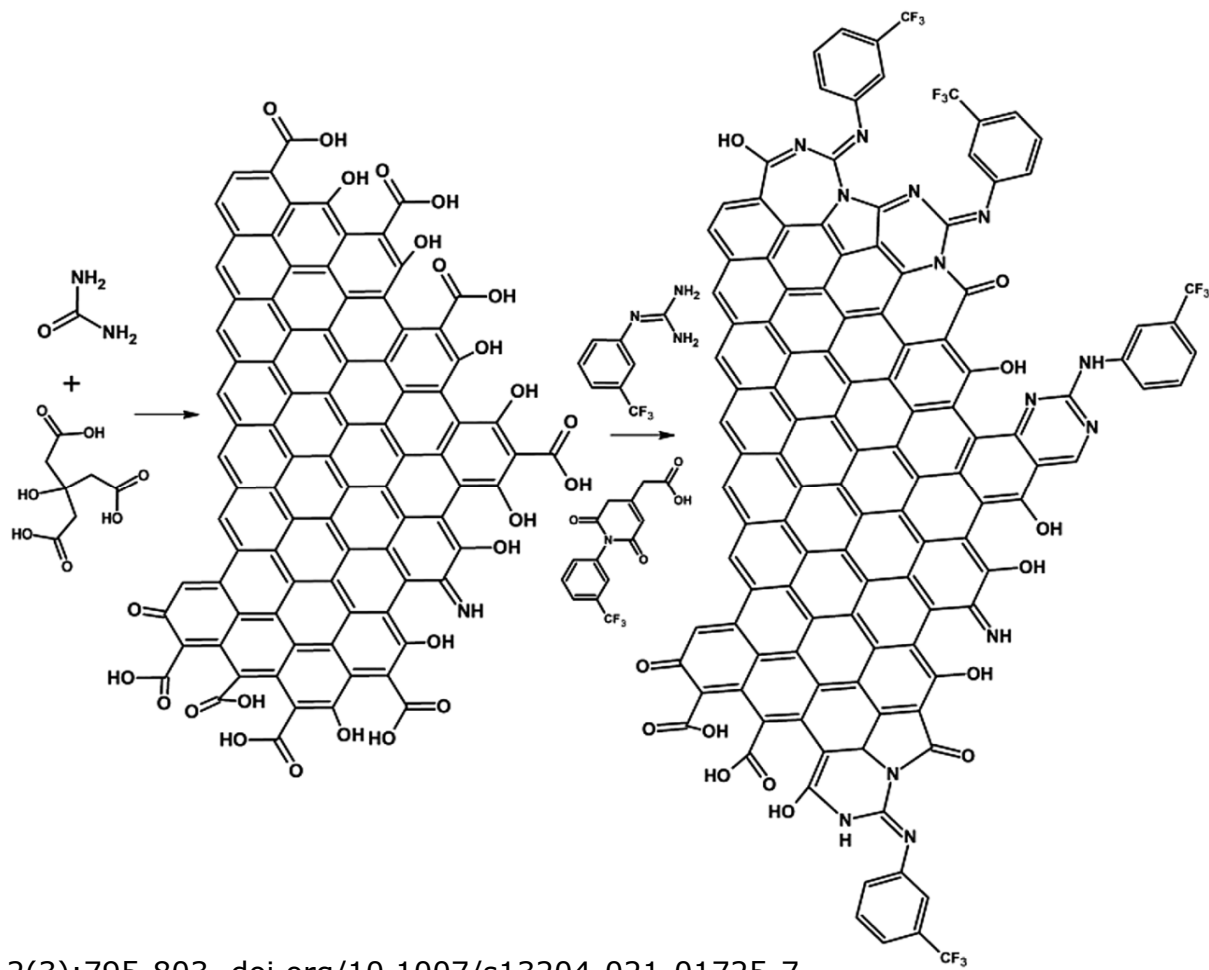
CDs' chemical structure

CDS,GE – surface enriched with ethylene-diamine groups

CDF19 - surface enriched with trifluoromethyl groups

CDS3011 - surface enriched with carboxyl groups

CDN19 - surface enriched with nitric groups

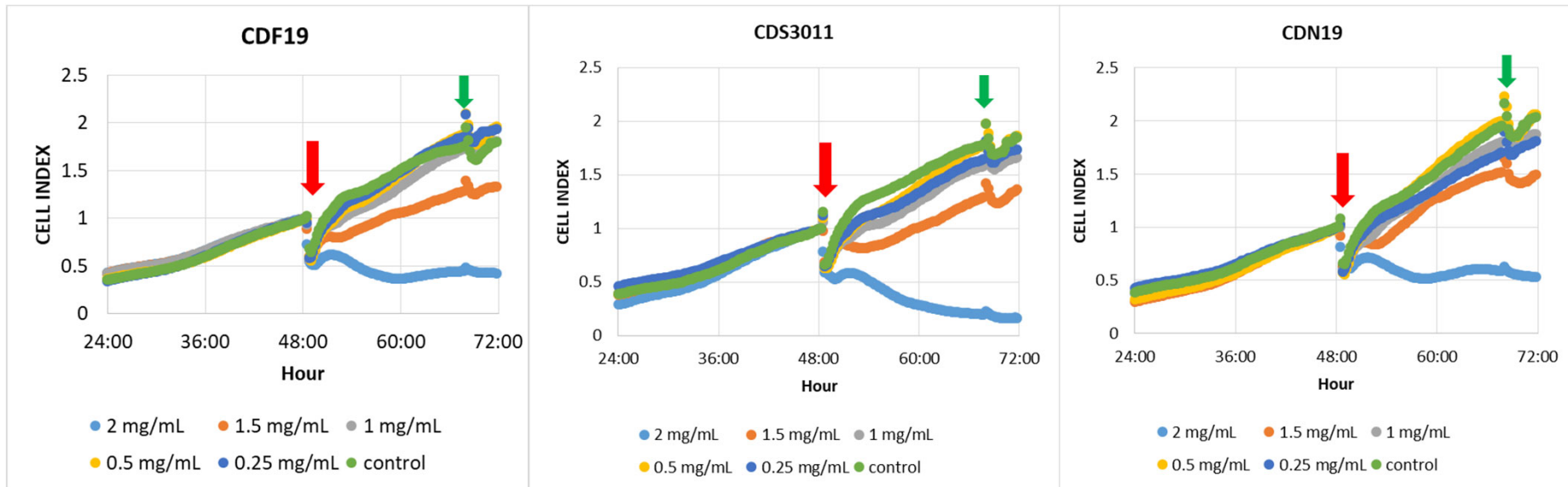


Lisnyak VV, et al. Appl Nanosci. 2022,12(3):795-803. doi.org/10.1007/s13204-021-01725-7

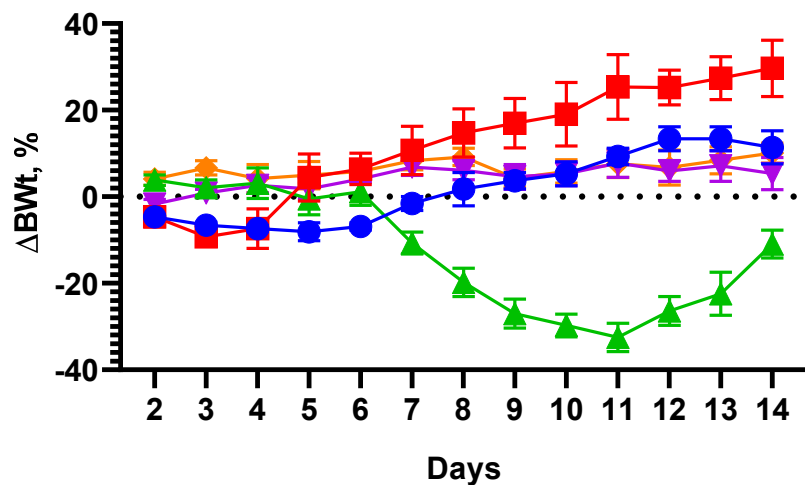


CDs dose selection. *In vitro* toxicity

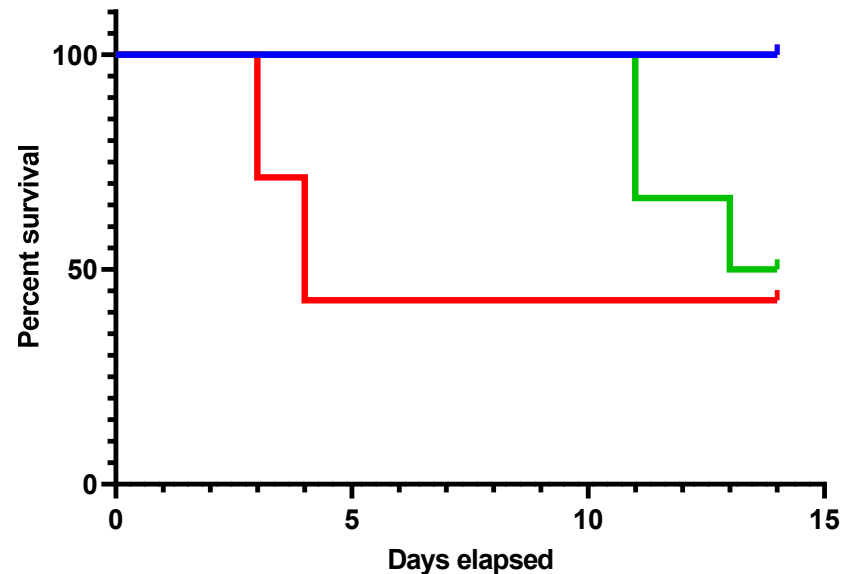
Impedance-based method to measure cell index (xCELLigence, ACEA Bio-sciences Inc., Biotek, Colmar, France)
A589 cell line



CDs dose selection. *In vivo* toxicity



● Vehicle ▲ CDS3011 ◆ CDS,GE
■ CDN19 ▼ CDF19



— Vehicle — CDS3011 — CDS,GE
— CDN19 — CDF19



Study design

Mice

C57Bl6 males 12-14
W.O.

Tumor xenograft

LLC 1×10^6 cell/mice

Doses of CDs

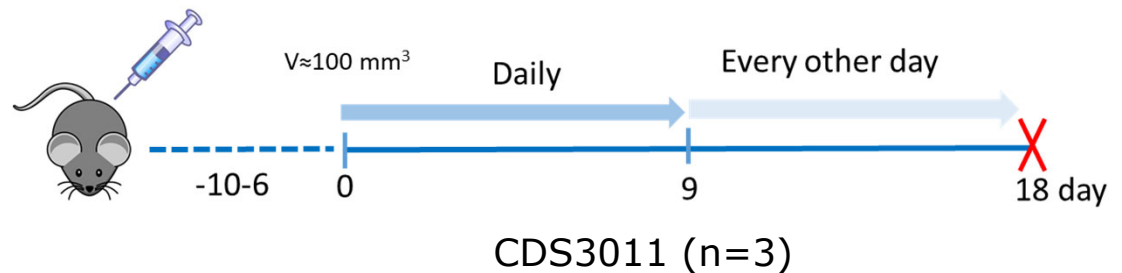
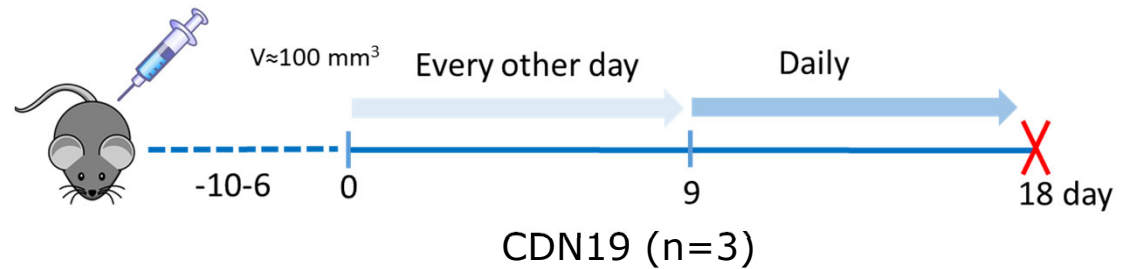
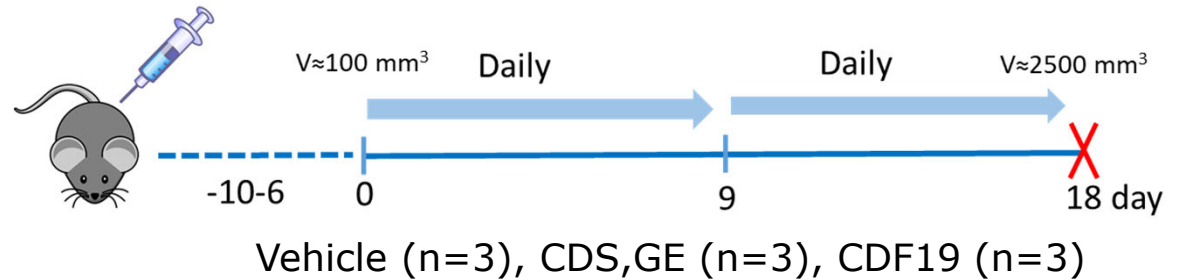
5 mg/kg in 5 mL/kg

Route

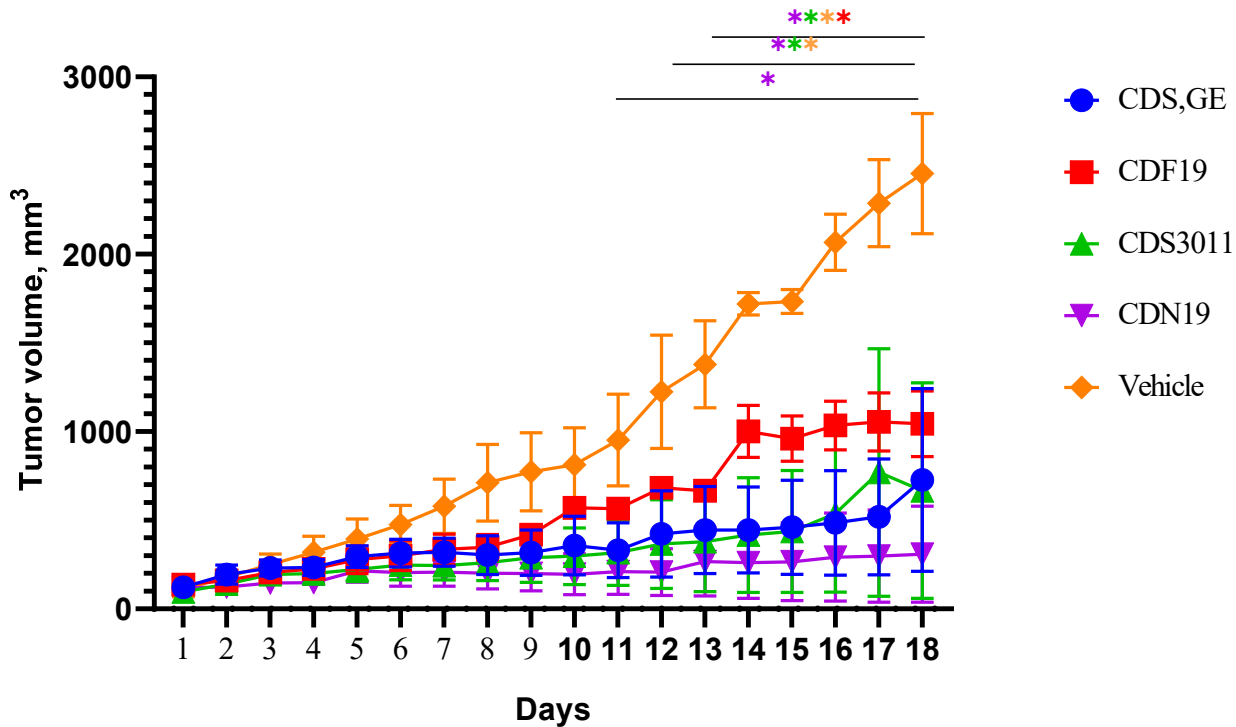
Intratumoral

Data collection

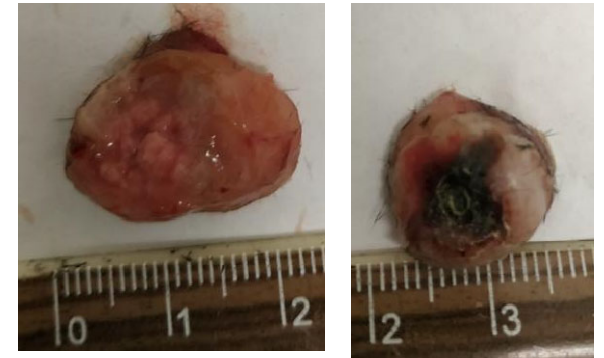
Tumor volume
measurements,
observations, weighing
- daily
Hematology,
biochemistry analyses
- terminal



Results. Antitumor activity

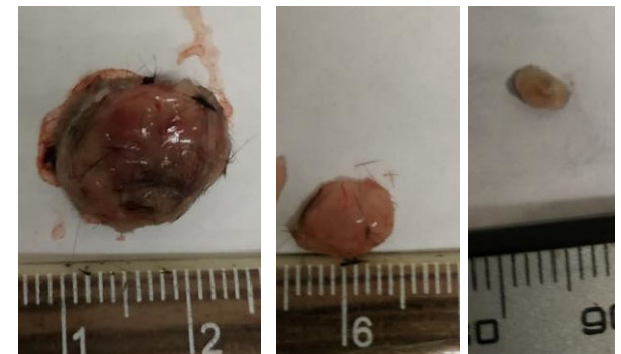


*p<0.05 compared to Vehicle



Vehicle

CDS,GE

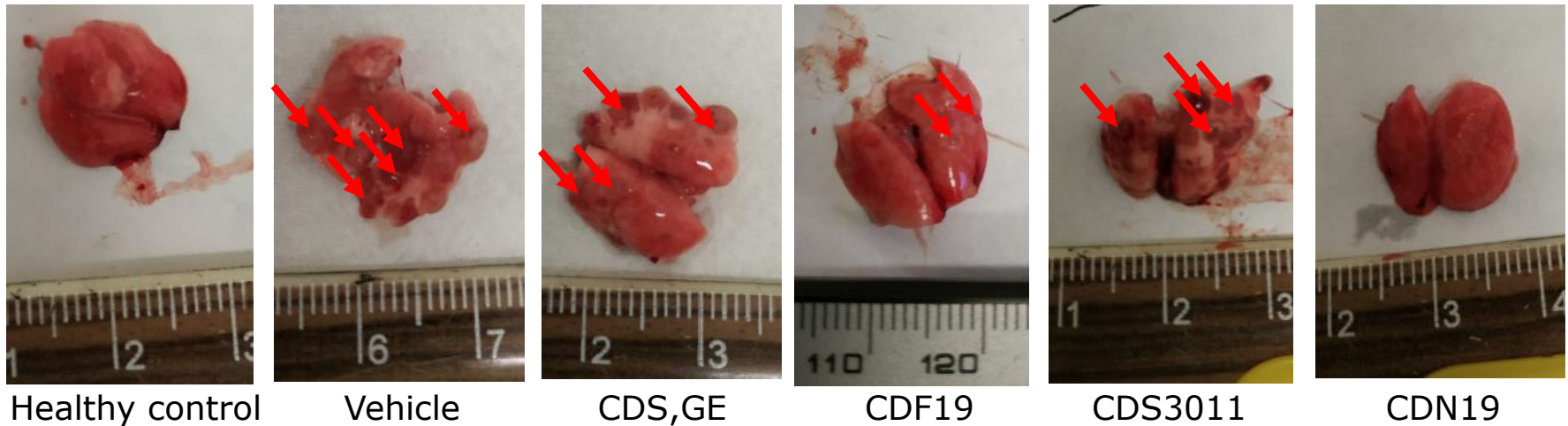
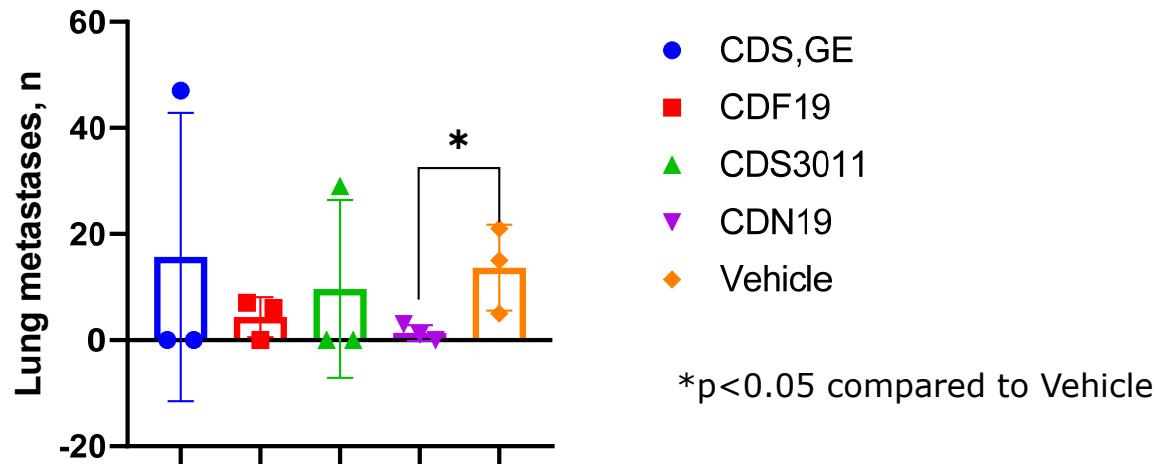


CDF19

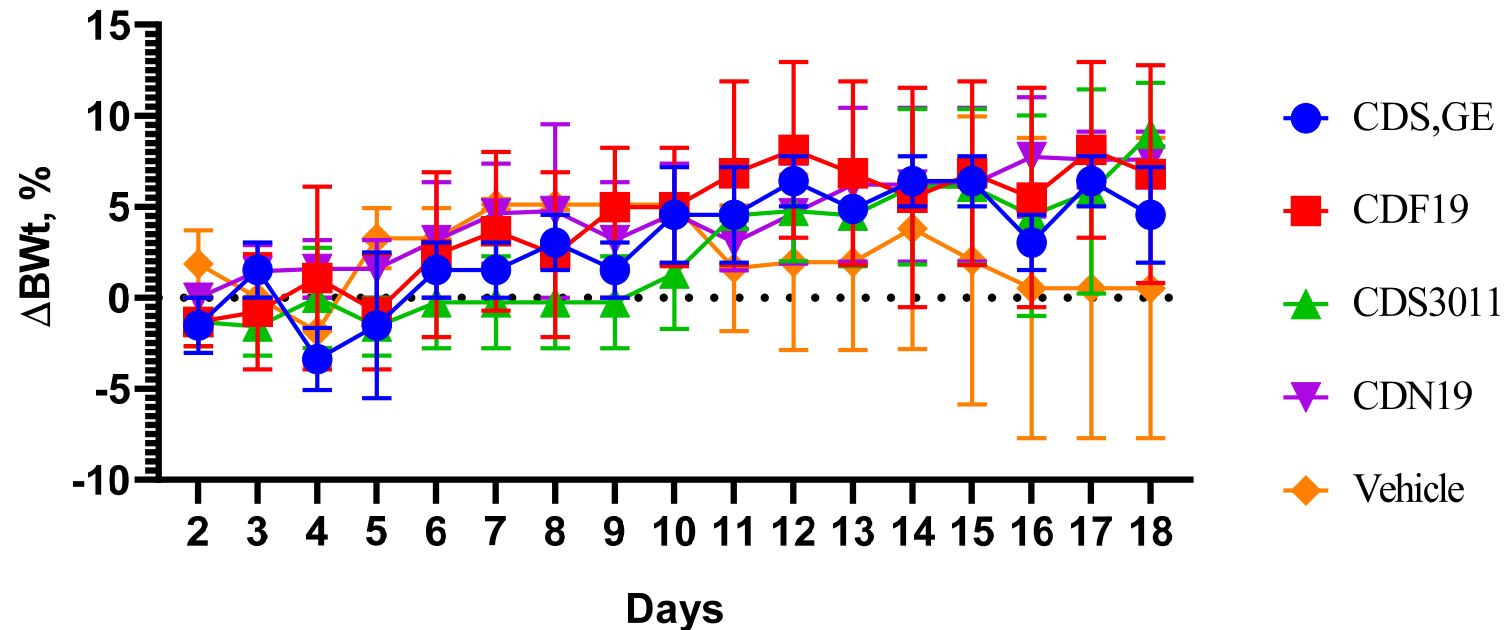
CDS3011

CDN19

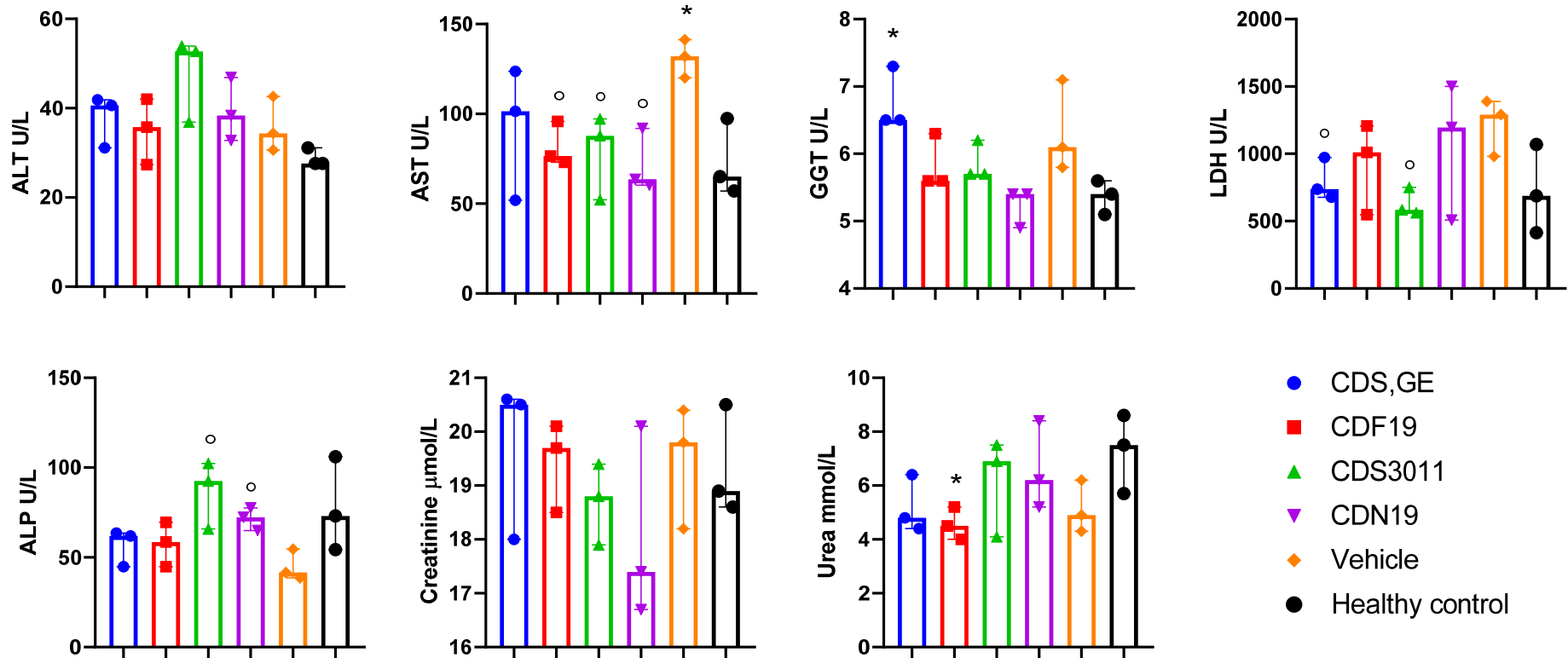
Results. Antitumor activity



Results. Toxicity, body weight changes

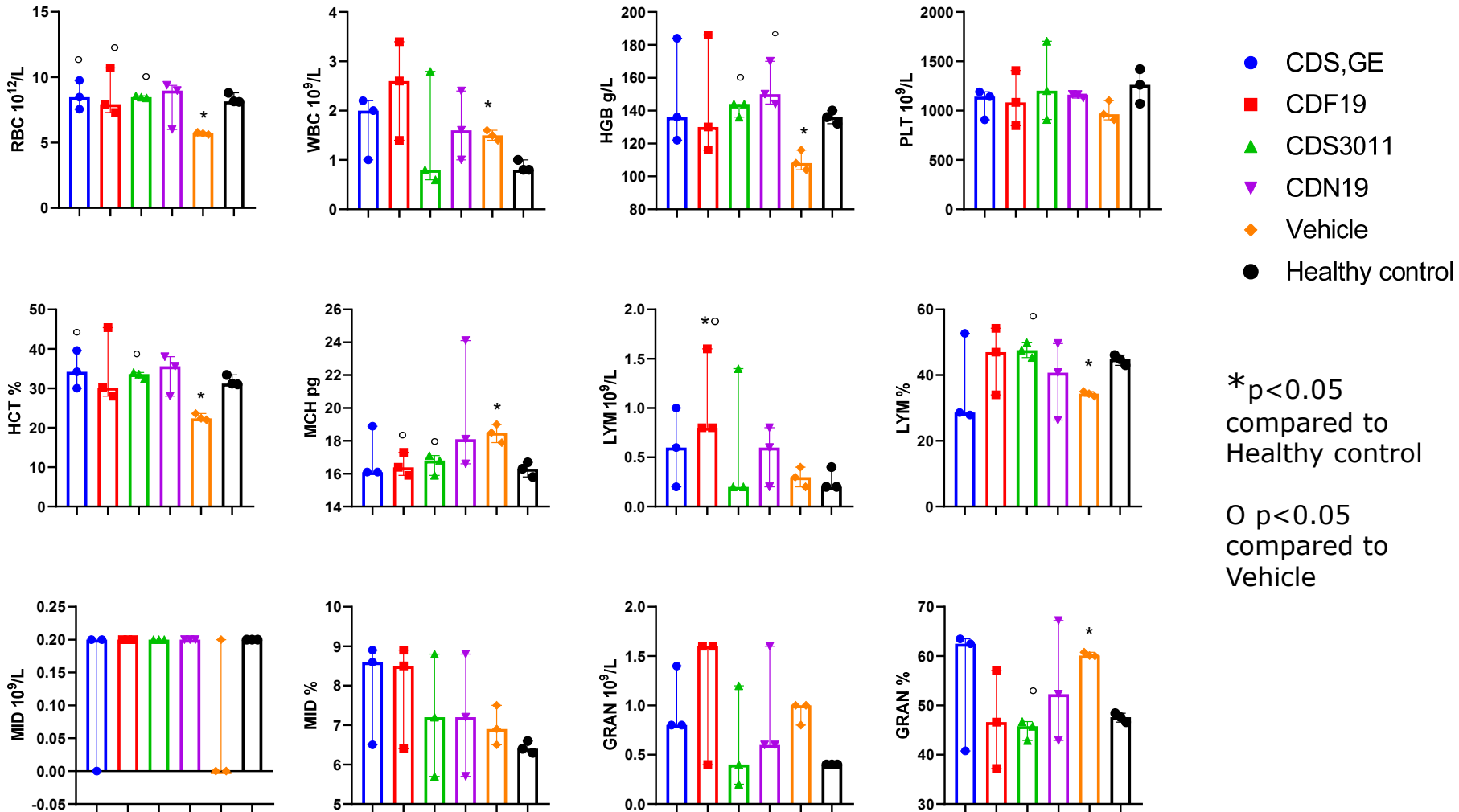


Results. Toxicity, biochemical analysis



* $p < 0.05$ compared to Healthy control, O $p < 0.05$ compared to Vehicle

Results. Toxicity, hematological analysis



Conclusions

- ▶ C57Bl6 LLC-bearing male mice treated with tested CDs during 18 days demonstrated significant decrease of tumor growth starting from the 12th-14th days of the study, which was observed for all CDS. **CDN19** had the highest tumor growth inhibition effect (by 87.5%), and **CDF19** had the lowest one (by 57.5%).
- ▶ Despite metastases were observed in all groups, **CDN19**-treated mice had significantly lower incidence of metastases.
- ▶ Tumor burden affected white and red blood cell physiology. All tested CDs partially normalized changed hematological parameters. The most effective was **CDS3011** (normalized values of 9 parameters each), and the less effective – **CDN19** (normalized HGB only).
- ▶ Tumor-bearing mice had altered serum biochemical values because of liver function alteration and tumor growth. All tested CDs partially normalized these changed parameters. The most effective was **CDS3011** (normalized values of 3 parameters), and the less effective – **CDF19** and **CDS,GE** (normalized 1 parameter only).

The best CD is ...

- ▶ The best antitumor CD - **CDN19**
- ▶ The best antimetastatic CD - **CDN19**

- ▶ The best protective CD against hematological disorders - **CDS3011**
- ▶ The best protective CD against biochemical disorders - **CDS3011**



Thank you for attention!

