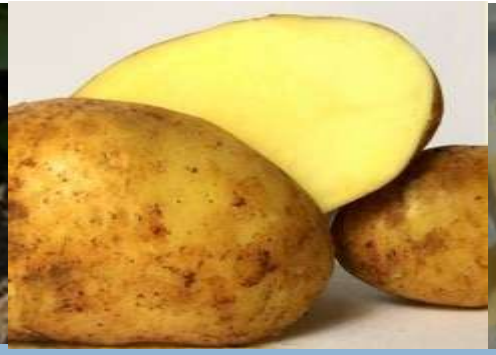
MRI
Max Rubner-Institut



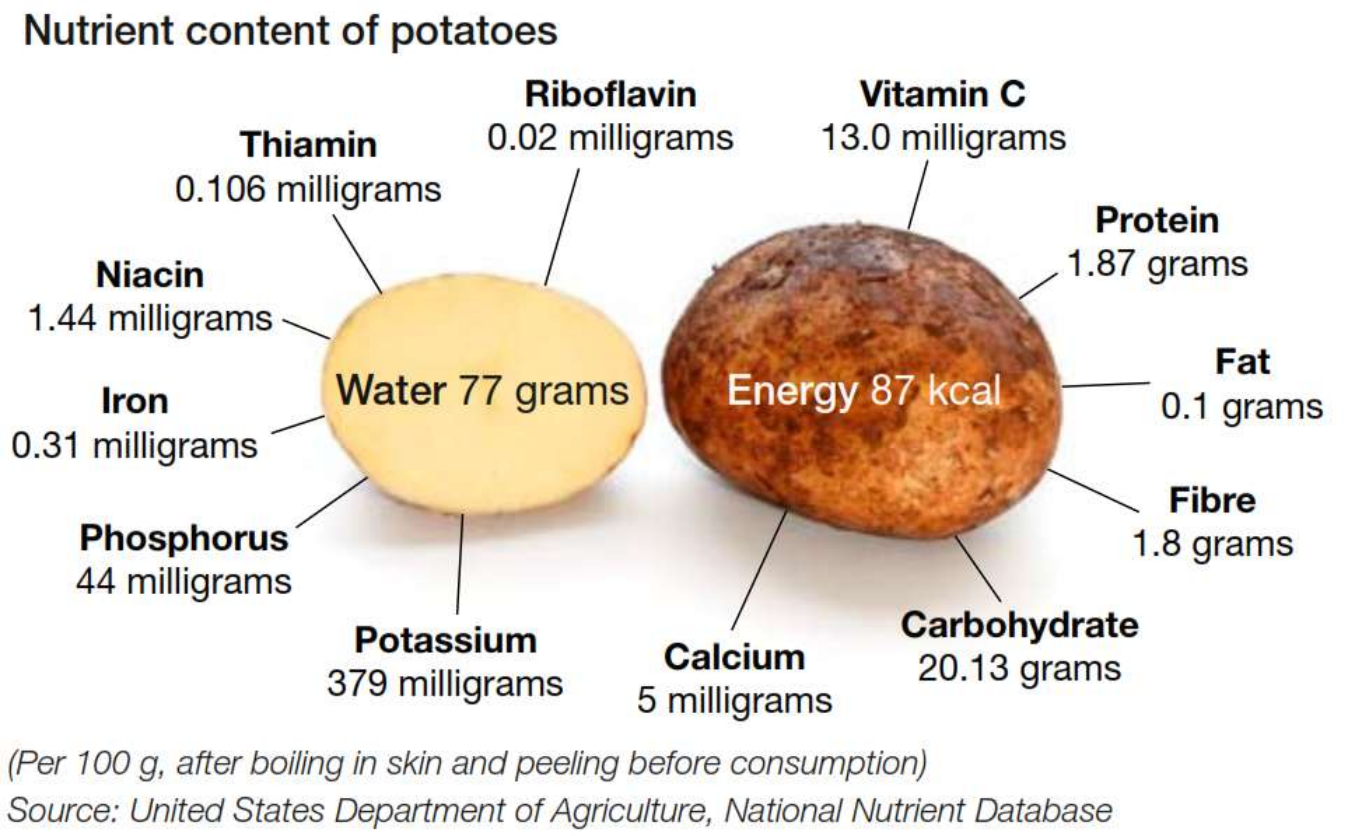



Risk Assessment of Post-Harvest Illuminated Potato Tubers

Norbert Haase and Lydia Weber
Department of Safety and Quality of Cereals

Potato as a Food

- Potato has become the 4th main crop in the world
- Potato is used world-wide in a variety of ways



from: IYP
Potatoes, nutrition and diet

Potato as a Food

- **But….**

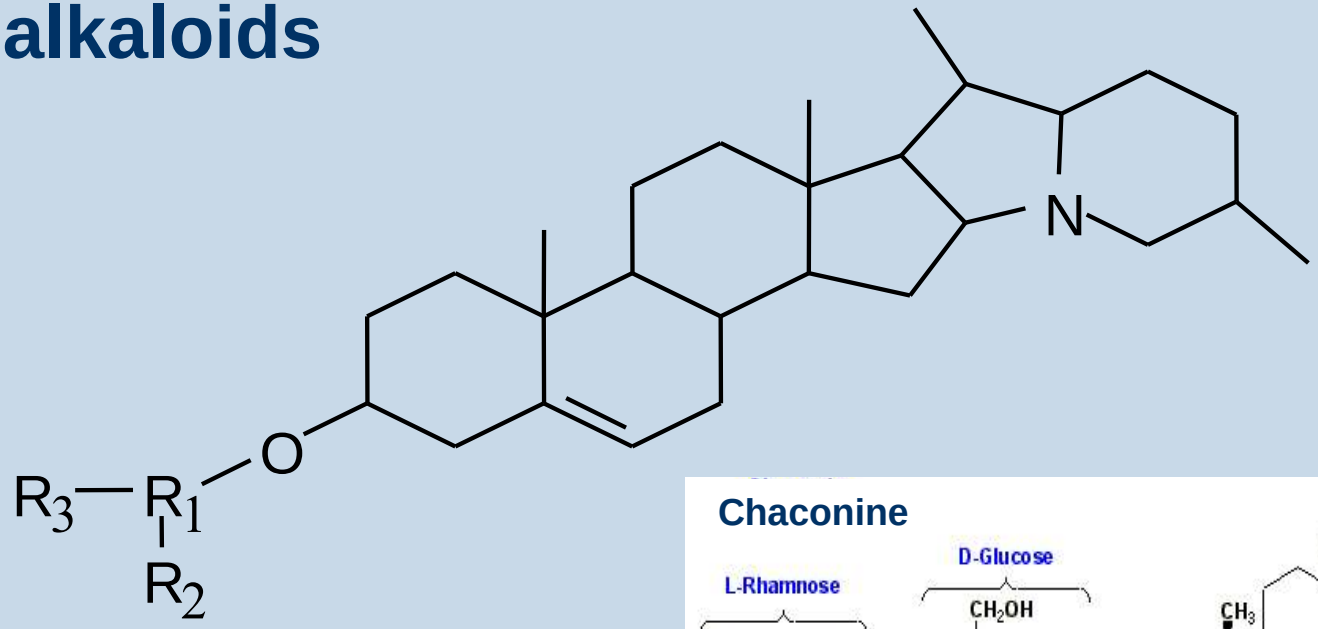
Toxic components of potato

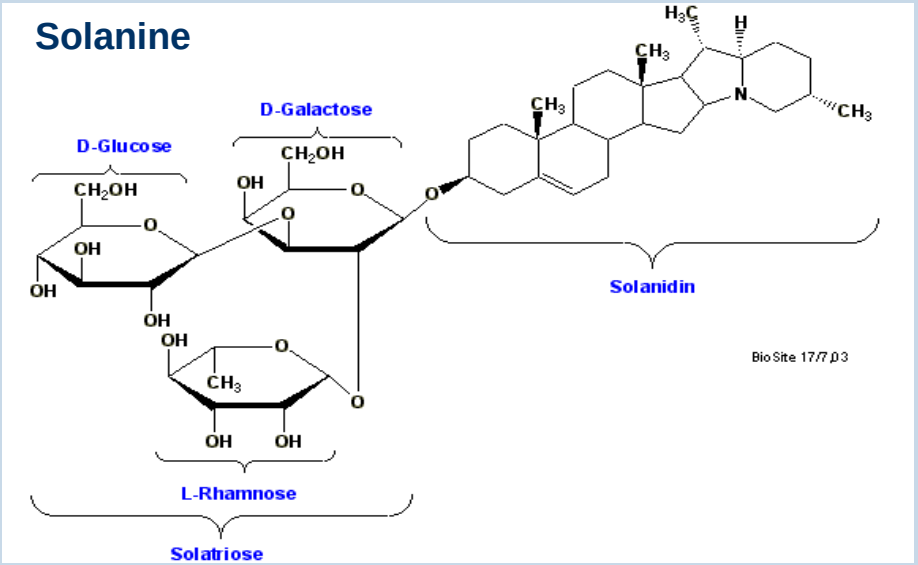
As part of the potato plant's natural defences against fungi and insects, its leaves, stems and sprouts contain high levels of toxic compounds called glycoalkaloids (usually solanine and chaconine). Glycoalkaloids are normally found at low levels in the tuber, and occur in the greatest concentrations just beneath the skin.

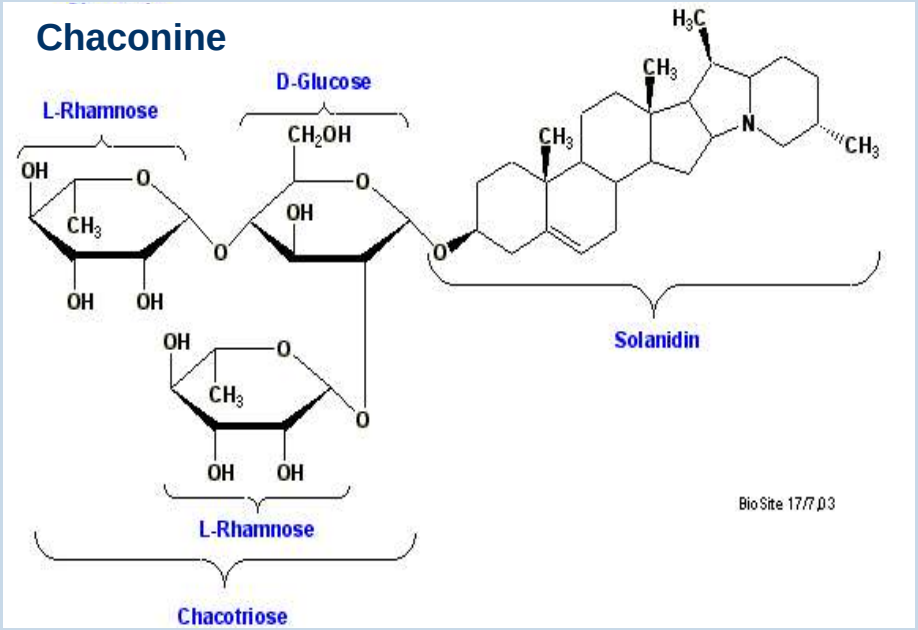
Potatoes should be stored in a dark, cool place in order to keep glycoalkaloid content low. Under exposure to light, potatoes turn green in colour due to increased levels of chlorophyll, which can also indicate higher levels of solanine and chaconine. Since glycoalkaloids are not destroyed by cooking, cutting away green areas and peeling potatoes before cooking ensures healthy eating.

from: IYP
Potatoes, nutrition and diet

Glycoalkaloids

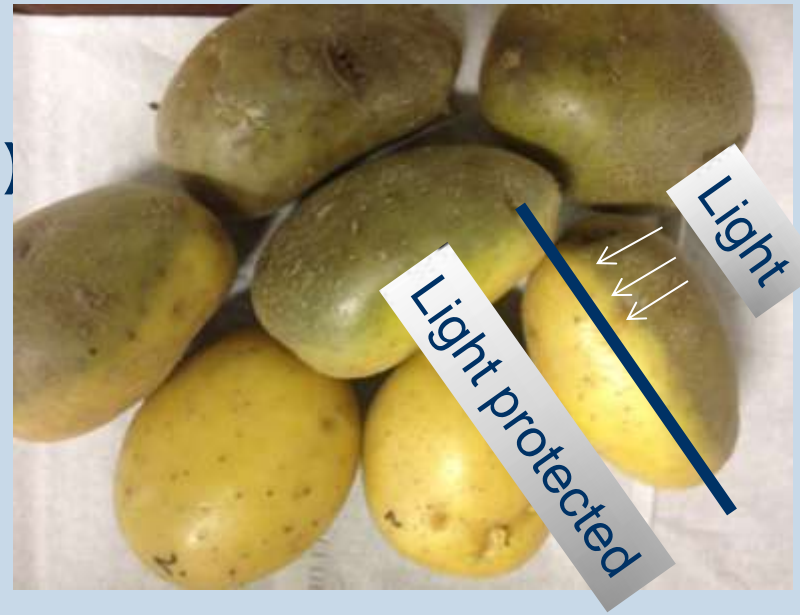


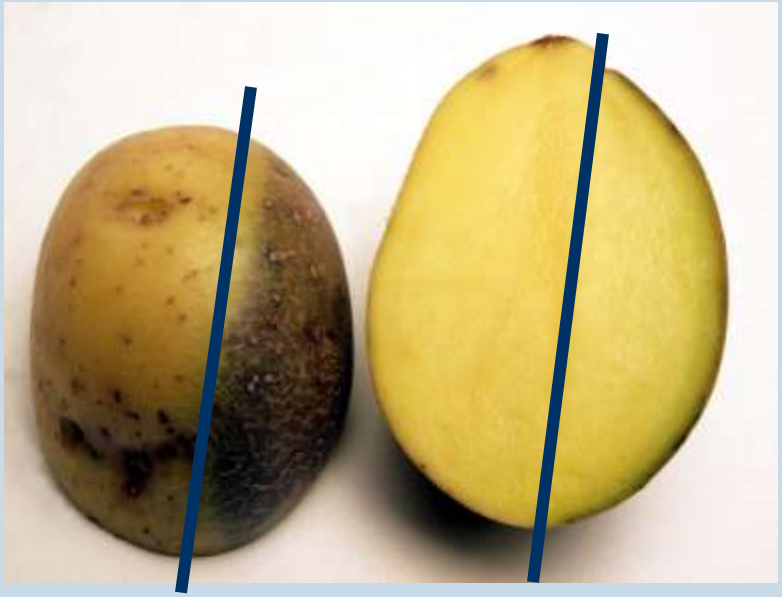




Glycoalkaloids in Potatoes (II)

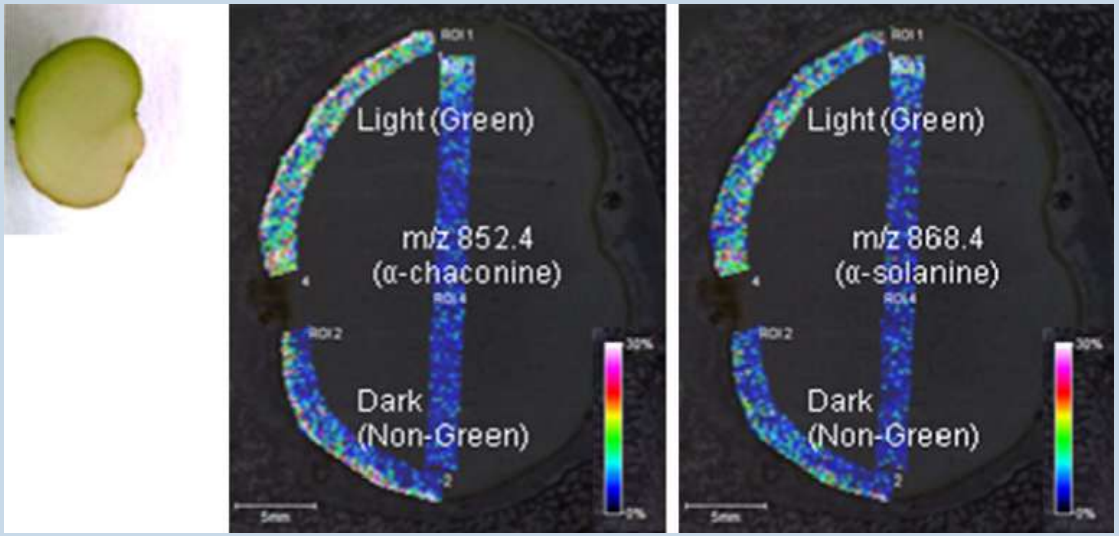
Local distribution (MALDI-TOF-Imaging)

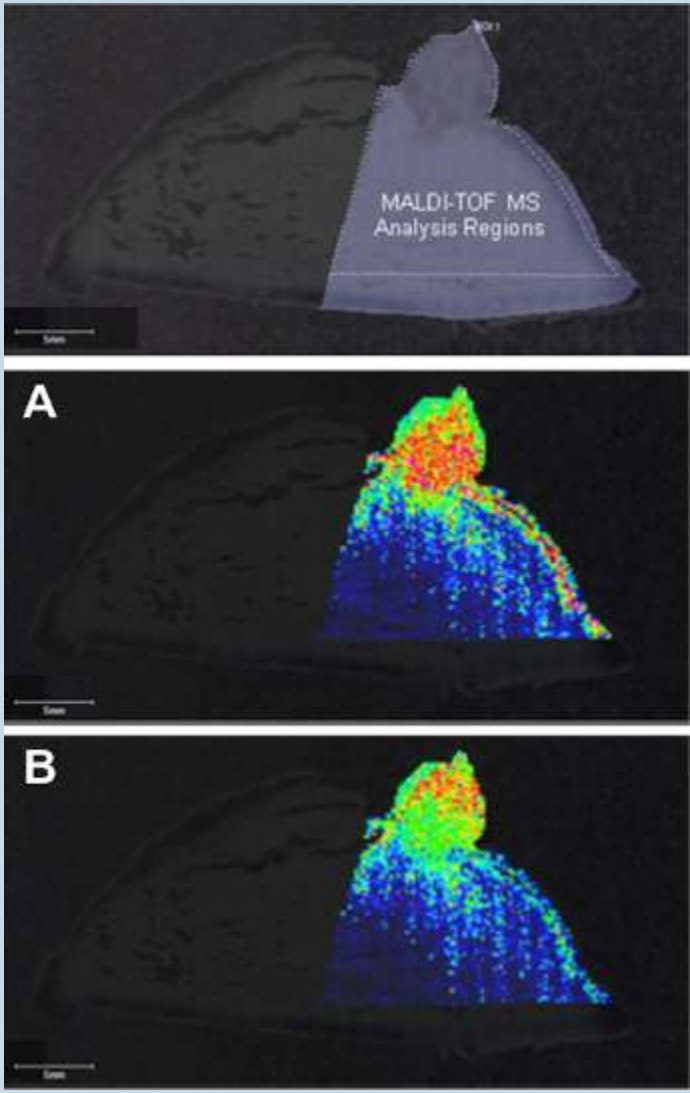




Glycoalkaloids in Potatoes (III)

Local distribution (MALDI-MSI)





From Ha et al.: Food Chem. 133 (2012), 1155

Glycoalkaloids in Potatoes

- **Bitter taste**
- **Potentially toxic *(Jadhav et al., 1983)*, hemolyt. reaction**
  - **→ Membrane destroy;**
  - **→ Blockage stimulus forwarding**
- **Tasty at 10 – 20 mg/100g FW potato**
- **Toxicity from up 1 mg/kg body weight (oral intake)**
- **Dosis between 3 – 6 mg/kg body weight meight be lethally.**
- **Threshold value of 200 mg glycoalkaloids/kg potato FW *(Bömer, A. and H. Mattis, 1924)***
- **On discussion: lowering to 100 mg/kg potato FW**
- **Composition of individual SGA: α-Solanine and α-Chaconine with 95%**

Toxicity

Animal experiments: LD_{50} at rats: 590 mg/kg BW

Lethal dose: monkeys: 50 mg/kg BW

Humans: more sensitive than animals

Experiments with prisoners: 2 mg/kg BW → toxic

Lethal dose: 3 – 5 mg/kg BW

→ **Light and also severe poisoning often not detected but diagnosed as gastroenteritis (stomach – gut – disease) „heavy stomach“**

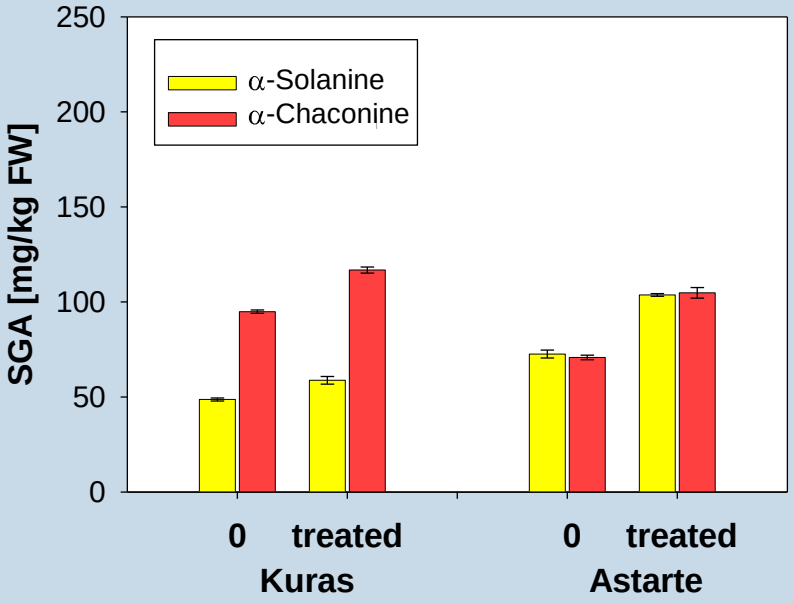
Glycoalkaloids Intake (Calculation)

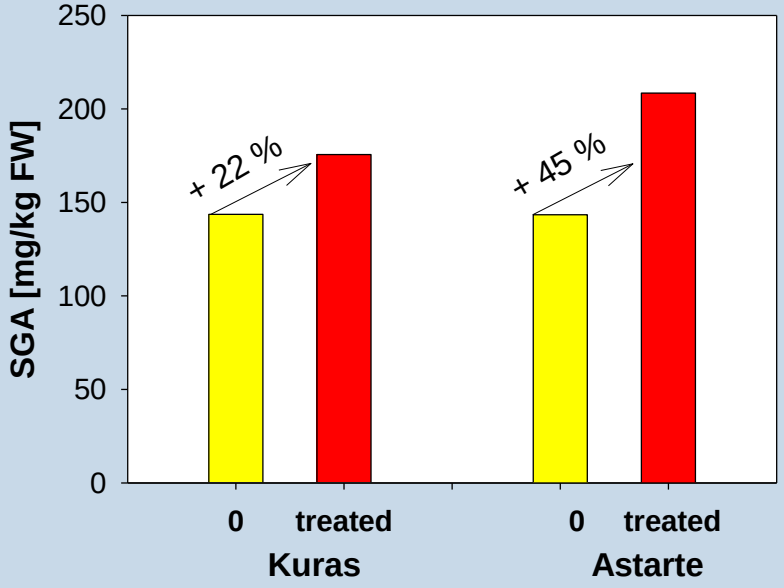
	peeled (5 mg/100 g FW)		unpeeled (20 mg/100 g FW)	
Consumption (g)	250	500	250	500
SGA-Intake (mg)	12.5	25	50	100
Person 1 (10 kg) → mg SGA/kg BW	1.2	2.5	5	10
Person 2 (60 kg) → mg SGA/kg BW	0.2	0.42	0.8	1.7

Potato Handling

- To be stored in the dark
- Cool storage
- Transport/movements
  → SGA increase?

Stress-induced SGA-increase





Methodology:

1 min, 30 mm stroke, 290 strokes min^{-1})

7 days storage at room temperature

Preparation for extraction: whole tubers

Potato Handling

- To be stored in the dark
- Cool storage
- Transport/movements
  → **SGA increase**

- Light exposure at point of sales

- Storage at home?

Statement

- **Initial quality drops down within the added value chain**
- **Especially at point of sales: little knowledge about the right potato treatment → illumination as a sales factor**
- **Consumers: also little knowledge for proper handling (storage at home)**

Questions to be answered

- **Principal glycoalkaloid enrichment in tubers after illumination?**

- **Exceeded upper safety level?**

Experimental

3 varieties x 4 locations x 2 analyses (harvest / storage)

Light exposure: 3 weeks à 10 h/d (October / April)

a) Pilot line
(Fluorescent lamps)

(15.6 µmol photons m^{-2} s^{-1} at 555 nm)

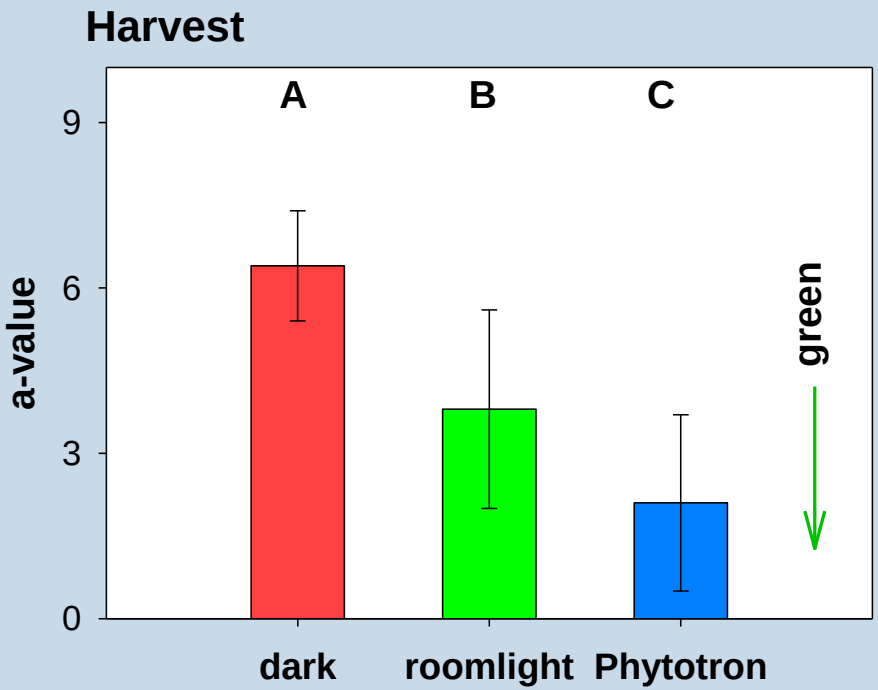
b) Phytotron
(Metal halid lamps)

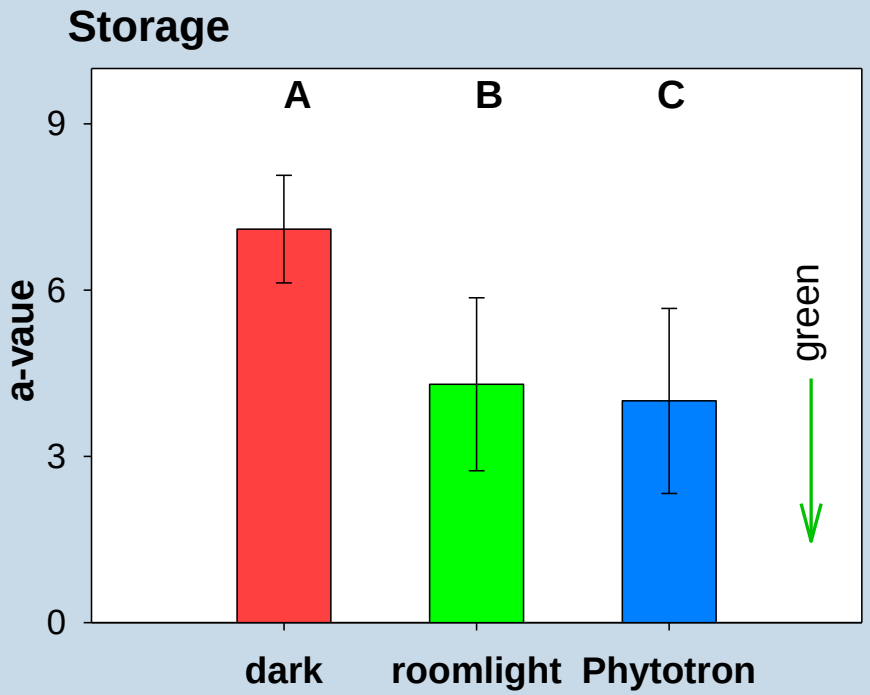
(32,5 µmol photons m^{-2} s^{-1} at 555 nm)

Preparation:

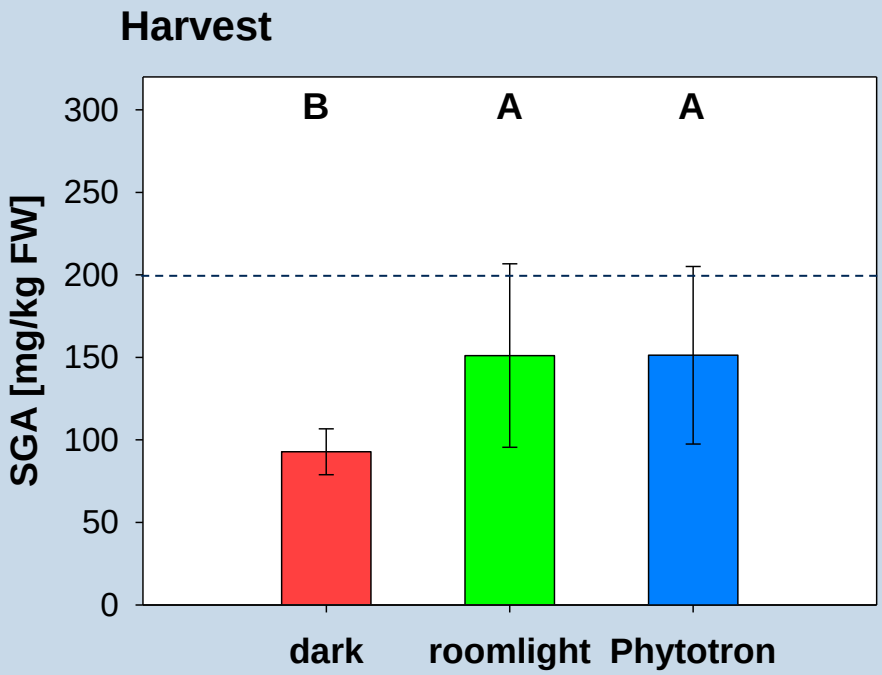
Colour measurement at upper half tuber
Upper half tuber: Separation peel/kernel
Stabilisation (Lyophilisat)
SGA-Analysis: HPLC; identification with pure substances

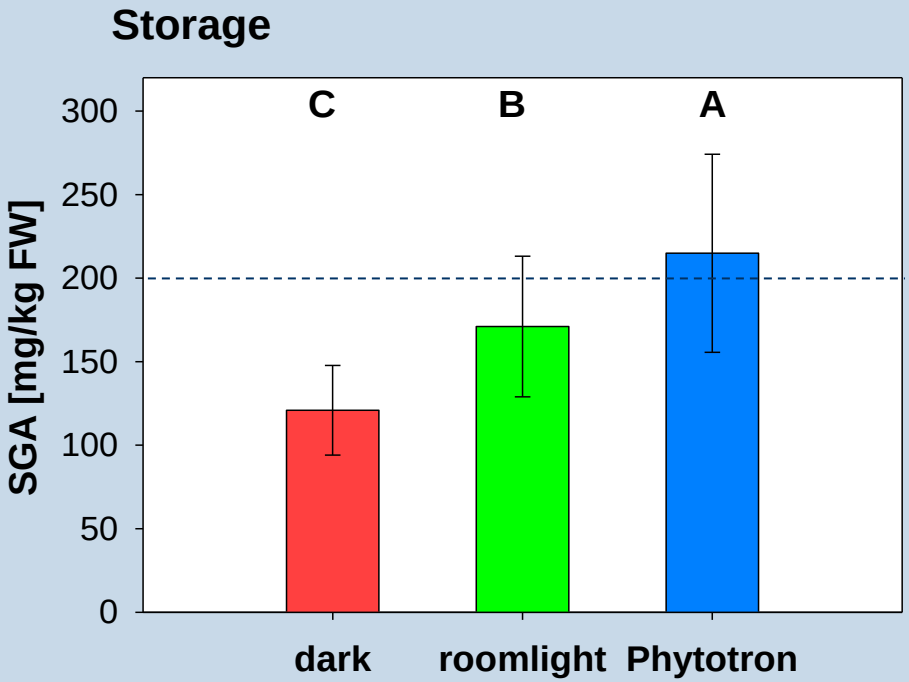
Illumination and a-Value (Greening)



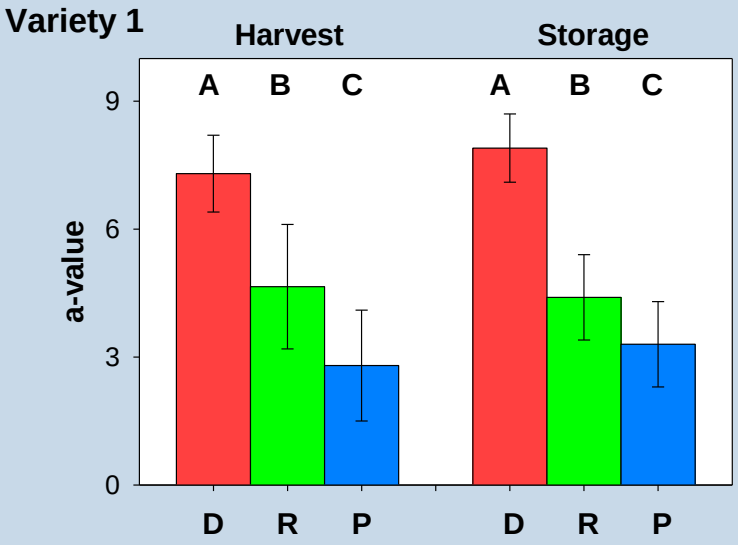


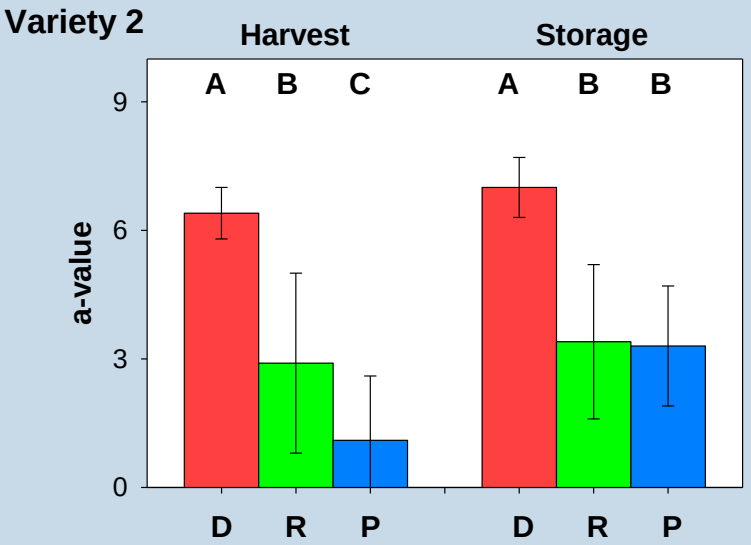
Illumination and SGA-Value

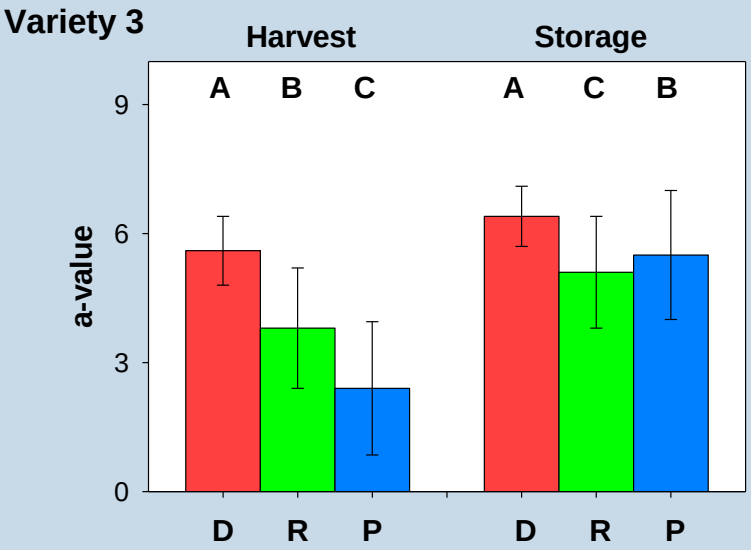




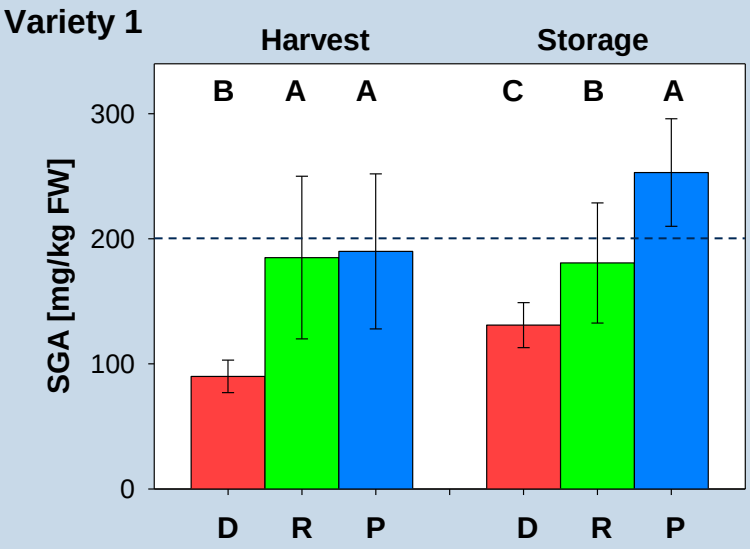
Variety-specific Colour Change (Peel)

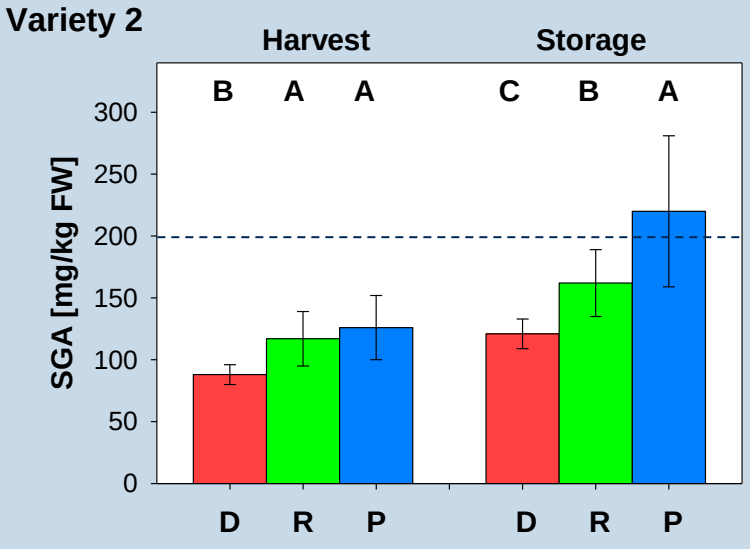


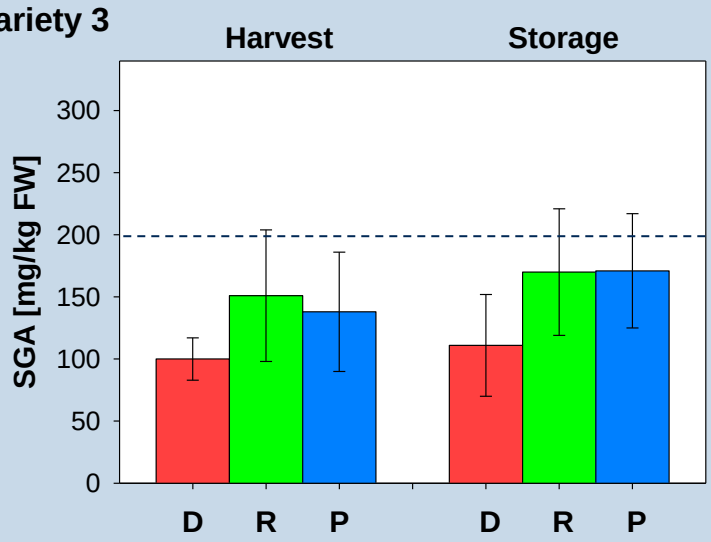




Variety-specific SGA-Values

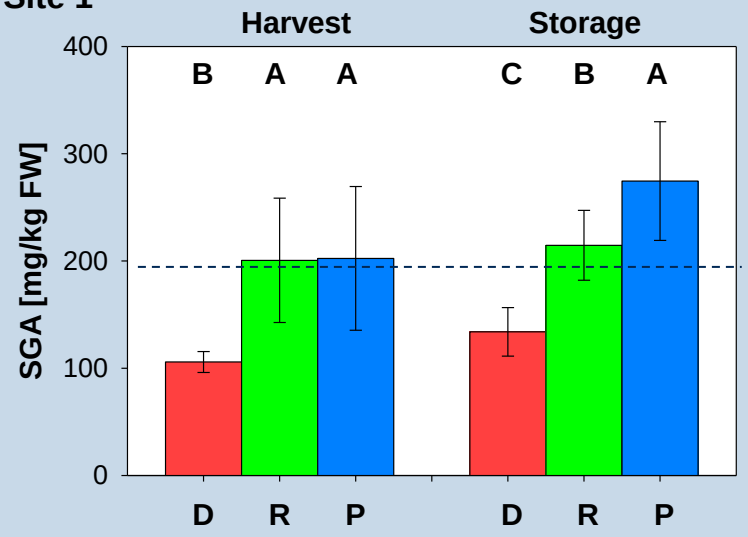




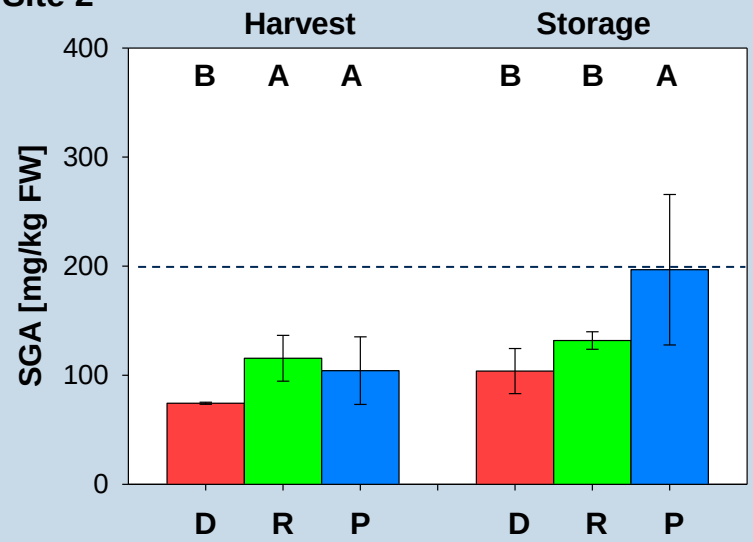


SGA-Values – Growing Locations

Site 1



Site 2



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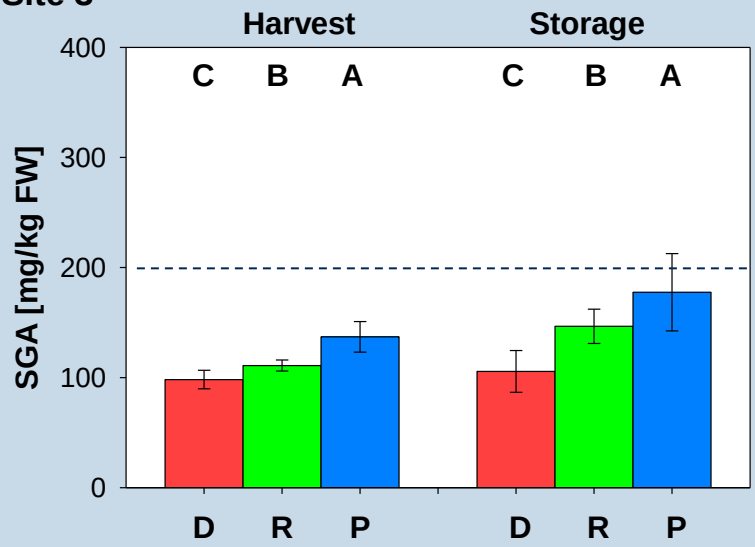

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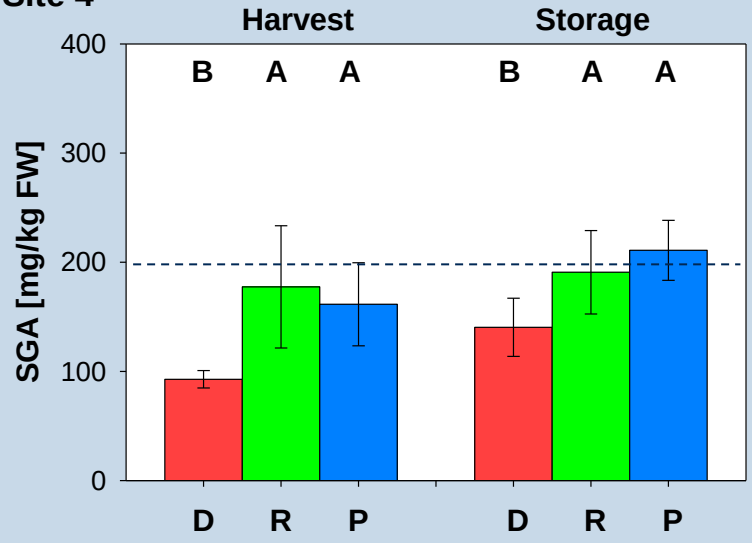

Summary

- „Stress“ increases SGA-values
- „Greening“ is associated with biochemical stress
- Glycoalkaloid synthesis increases under illumination
- After storage SGA-values were increased in most cases
- SGA-expression to be influenced by genotype (variety), illumination intensity, origin
- Advices for use of green tubers are still relevant (cut away generously/reject)
- Tuber-specific de-toxification a tool for future breeding?