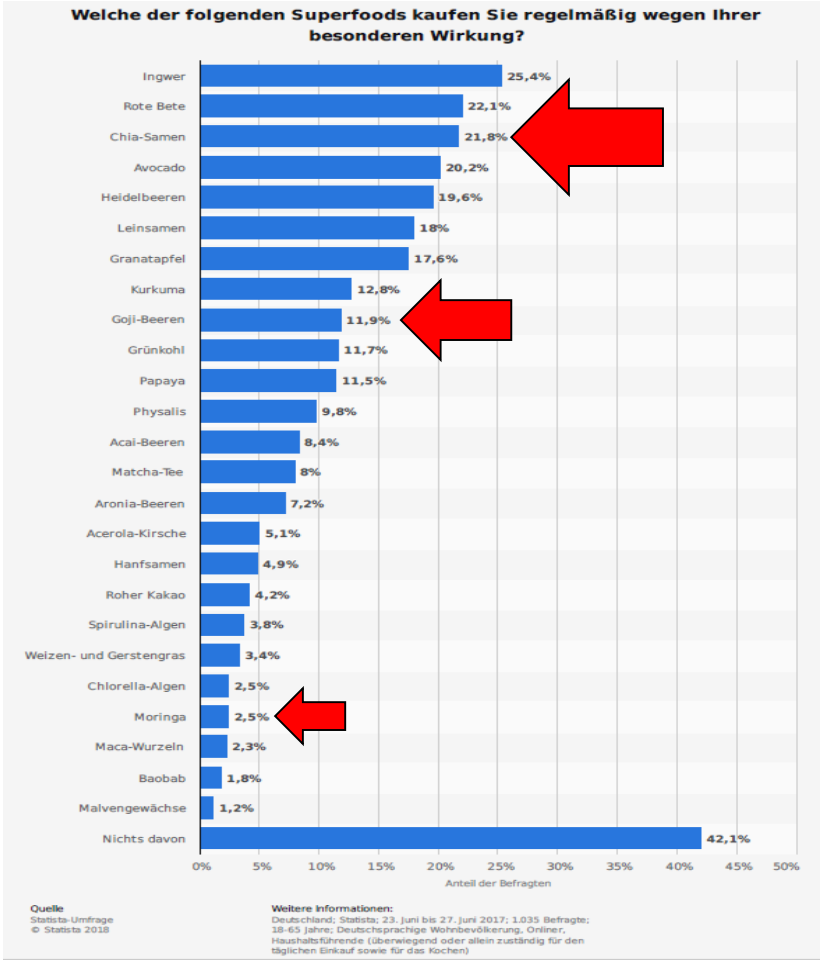
Combatting counterfeit superfoods

SWR - https://www.swr.de/wissen/gefaelschtes-superfood/

1. Superfood: economically „super“!
2. Superfood: medically „super“?
3. Botanical globalisation
4. How to safeguard consumer safety
5. Case studies: Tulsi, Chia, herbal teas
6. What we need

1. Superfood: economically „super“!



„Superfoods“ – a growing market

Factors:

- Ageing society
- Growing health awareness
- Increase of stress-related syndromes
- Self-optimisation as ideology
- Experimental spirit („try something new“)
- Romantic exoticism
- Food trends (veganism)

Exotic superfoods:

- Chia, Goji, Moringa, Tulsi, Acai, Barley Grass
- Herbal teas (volatile markets with rapid change)

Combatting counterfeit superfoods

Botanisches Institut

Karlsruher Institut für Technologie

1. Superfood: economically „super“!

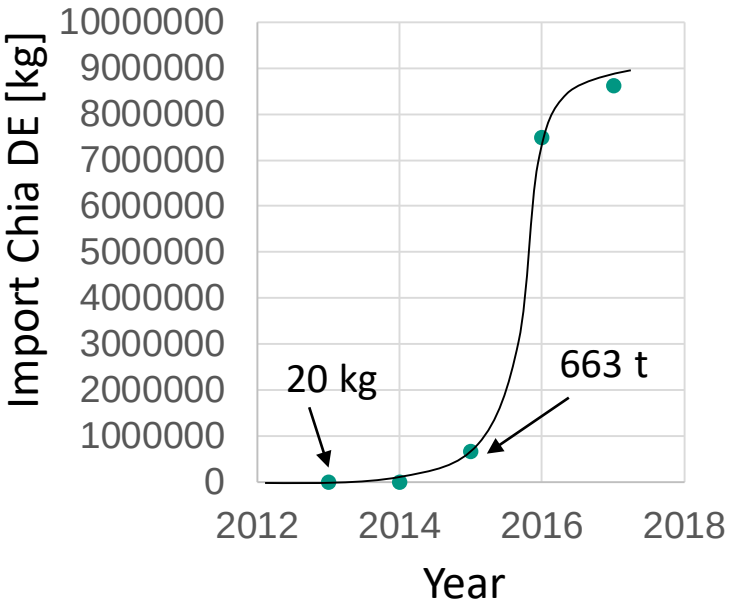
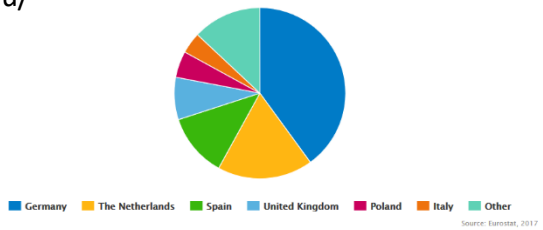


Figure 1. Main European importers of oilseeds from selected supplying markets in 2016, in volume

www.cbi.eu/

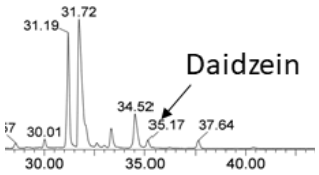


Case study Chia

- Traditionally: Mexico, local crop
- Since 2009 admitted in Europe (*Novel Food*)
- Since 2015 tremendous increase of imports
- Thus new producers (Africa, Paraguyai)
- Drastic price drop in Mexico
- Africa with two harvests gains volume
- Quality: doubtful, because experience lacks
- Superfood in discounters fuelling demand
- Falling price reduce profits
- Quantity wins over qualtiy
- What are quality traits here? Unclear.
- What is „Chia“? Several species are traded!

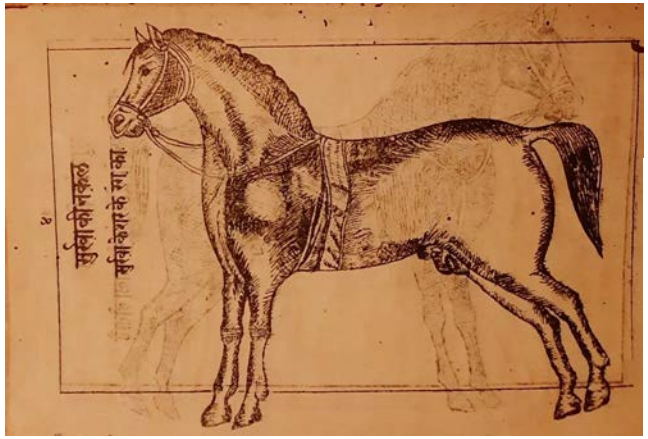
2. Superfood: medically „super“?

Moringa, Botanischer Garten



Moringa, Handelsprobe

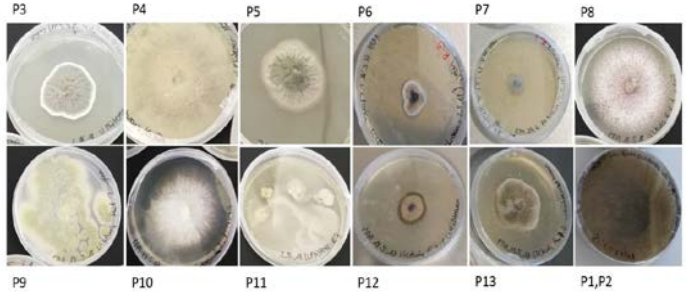
Assay for phytoestrogenes (Diploma thesis Pfisterer)



Case study Moringa

Tradition

- Long tradition in Ayurveda
- Application: Veterinary (horses, elephants)
- Active compound: unknown
- Ads: „a lot of protein“, „nutrients“ (vague)
- Literature: phytoestrogenes (specific)
- Verification: not true, fairytale
- Quality: often variable (fungi)



Isolation of different molds from commercial Moringa samples (Diploma thesis Pfisterer)

2. Superfood: medically „super“?

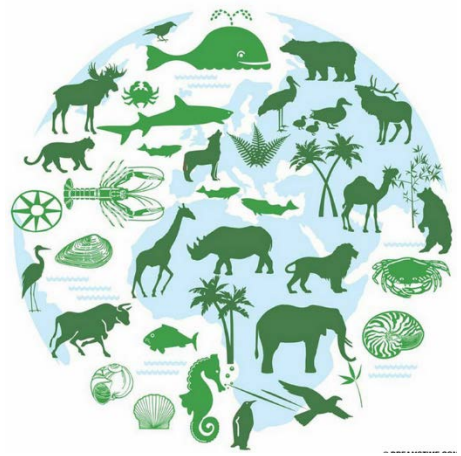
Case study Barley Grass

- Reactive Oxygen Species (ROS) as risk factor
- Antioxidants scavenge ROS
- Often secondary plant compounds
- Ads: Superfood with a lot of antioxidants
- Barley Grass as miracle diet
- Inventor founded later in the US „Greens“
- Marketing: for smoothies, high price

We have checked it out

Comparison of different commercial products with respect to ROS scavenging (different assays)
Result: big differences – some products were active, others barely. Caveat: high price is no guarantee for bioactivity!

3. Botanical globalisation



Bundesamt für Verbraucherschutz und Lebensmittelsicherheit

Globalisation:
Many products from all over the world are sold all over the world – including Europe

Biodiversity:
Many species of plants and animals live (still) on our planet. There is a long culture of their use by and for humans.

Conflict of interests
Globalisation shifts biodiversity from ist original cultural context and places it elsewhere. What does this mean for consumer safety?

3. Botanical globalisation

True Chamomile
Matricaria chamomilla
„Mutterkraut“
(Mother Wort)

Peppermint
Mentha x piperita
„Mutterkraut“
(Mother Wort)

Traditional ≠ scientific nomenclature

Functional effect is based on quality. Quality is based on standards. This requires that terminology is unequivocal.

Scientific nomenclature must be unequivocal. Traditional names often are not (even in Europe!).

Why? Because the vernacular name for a plant often derives from its application:

Chamomile: „Mother Wort“ – antiseptic acttion against Childbed Fever

Peppermint: „Mother Wort“ – anestheticum during birth labour

3. Botanical globalisation

EU-law: each thing has one name, this is absolute

Tradition: each activity has several names, these depend on the context

Case study: TCM

川木通
chuan mu tong=
Fluss-Ppbaum

木通
mu tong =
„Pisspott-Baum“

Clematidis armandii

Stephaniae tetrandrae

漢防己
han fang ji =
Hanfluss-Schlmed.

防己
fang ji =
„Schlangenmedizin“

關木通
guan mu tong =
Öffner-Ppbaum

Aristolochia manschuriensis

Aristolochia manschuriensis

廣防己
guan(g) fang ji =
breite Schlm

3. Botanical globalisation

THE LANCET
Volume 341, Issue 8842, 13 February 1993, Pages 387-391

doi:10.1016/0140-6736(93)92984-2 | How to Cite or Link Using DOI

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ARTICLES

Rapidly progressive interstitial renal fibrosis in young women: association with slimming regimen including Chinese herbs

Prof J-L. Vanherweghem MD[a], C. Tielemans MD[a], D. Abramowicz MD[a], M. Depierreux MD[b], Prof R. Vanhaelen-Fastre PhD[c], M. Vanhaelen PhD[c], M. Dratwa MD[d], C. Richard MD[e], D. Vandervelde MD[f], D. Verbeelen MD[g] and M. Jadoul MD[h]

Purchase

The Journal of Alternative and Complementary Medicine

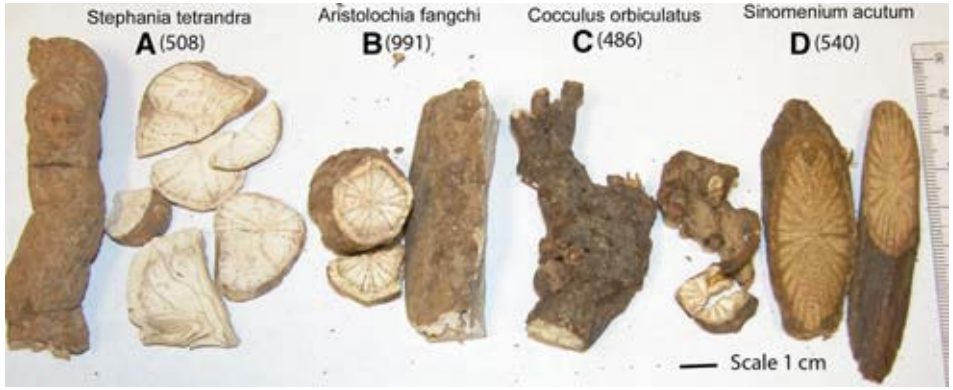
Misuse of Herbal Remedies: The Case of an Outbreak of Terminal Renal Failure in Belgium (Chinese Herbs Nephropathy)

To cite this article:
Jean-Louis Vanherweghem. The Journal of Alternative and Complementary Medicine. Spring 1998, 4(1): 9-13. doi:10.1089/acm.1998.4.1-9.

Published in Volume: 4 Issue 1: February 20, 2008

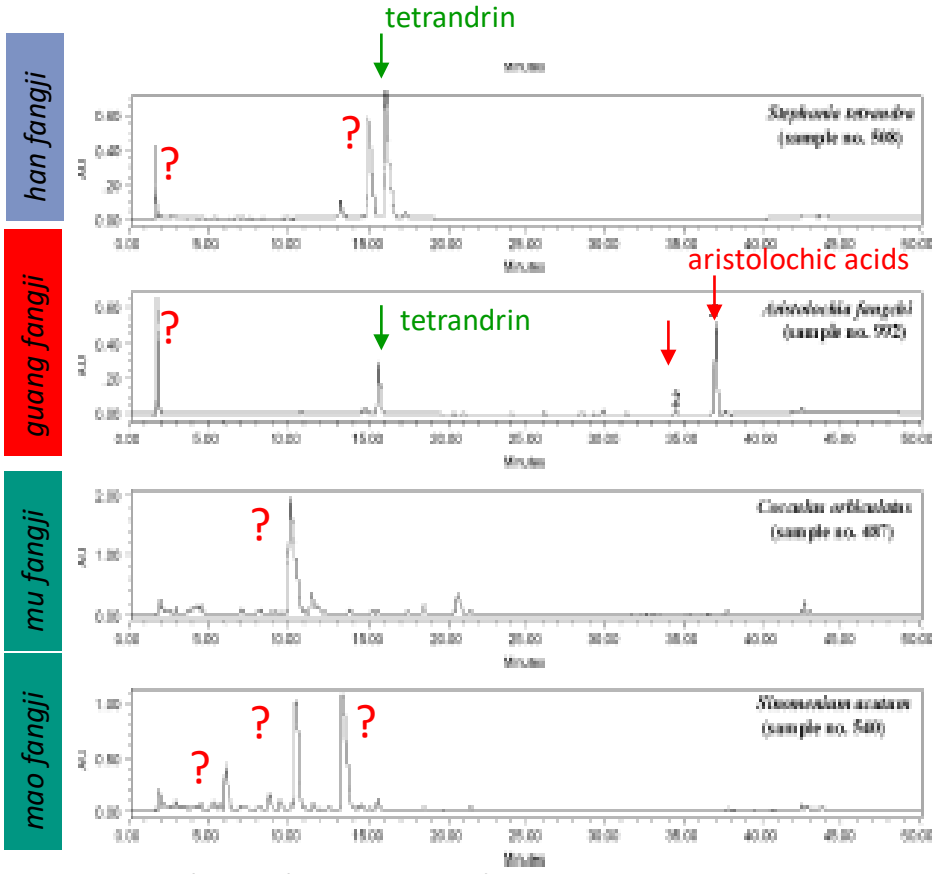
Why we cannot let this run freely

Belgium: more than 100 women lost their kidneys after a slimming cure on TCM base



Preparation: *(han) fangji* (*Stephania tetandrae*), but they got *(guang) fangji* (*Aristolochia fangchi*) – linguistic ambiguity with fatal consequences…

4. How to safeguard consumer safety?



Joshi et al., J. Nat. Med., 2008

Chemical analytics

Separate the compounds

Identify by standards

Problems

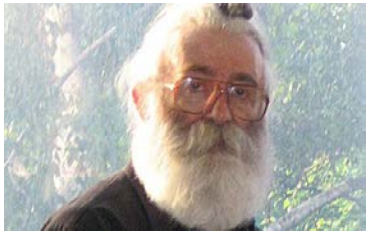
Often the compounds are unknown (what causes the effects of „Chia“ and „Moringa“?)

Often the effect depends on synergies

Often content depends on the environment

We need something unchangeable to find out, what plants are really in the product!

4. How to safeguard consumer safety?


Radovan Karadžić or „*fangji* remains *fangji*“, even with beard…


Mix from

廣防己 *guan(g) fang ji* = Breite Schlangenmedizin

華防己 *han fang ji* = Hanfluss-Schlangenmedizin

The idea of *Genetic Barcoding*

Biological identity is determined by the genes.

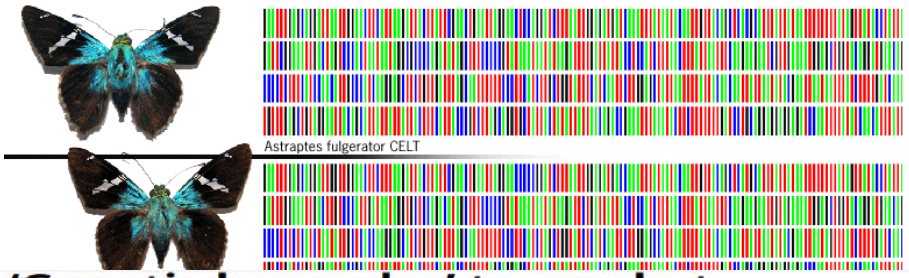
All cells contain the same DNA.

What is „read out“, differs, though (depending on development and environment).

Identificiation via DNA does not depend on development/environment!

Advantage: this works also in processed samples (commercial products)

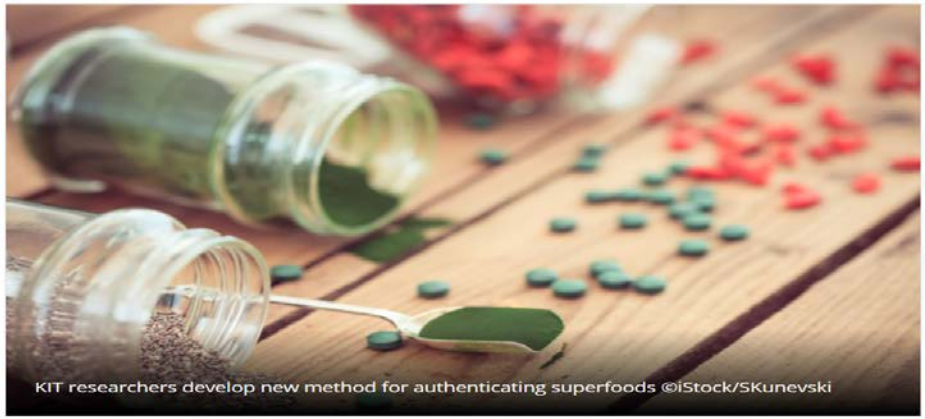
4. How to safeguard consumer safety?



'Genetic bar codes' to combat counterfeit superfoods

By Katy Askew

02-Mar-2018 - Last updated on 02-Mar-2018 at 14:29 GMT



Researchers at the Karlsruhe Institute of Technology (KIT) have developed "genetic bar codes" that, they say, can be used to identify fake "superfoods".

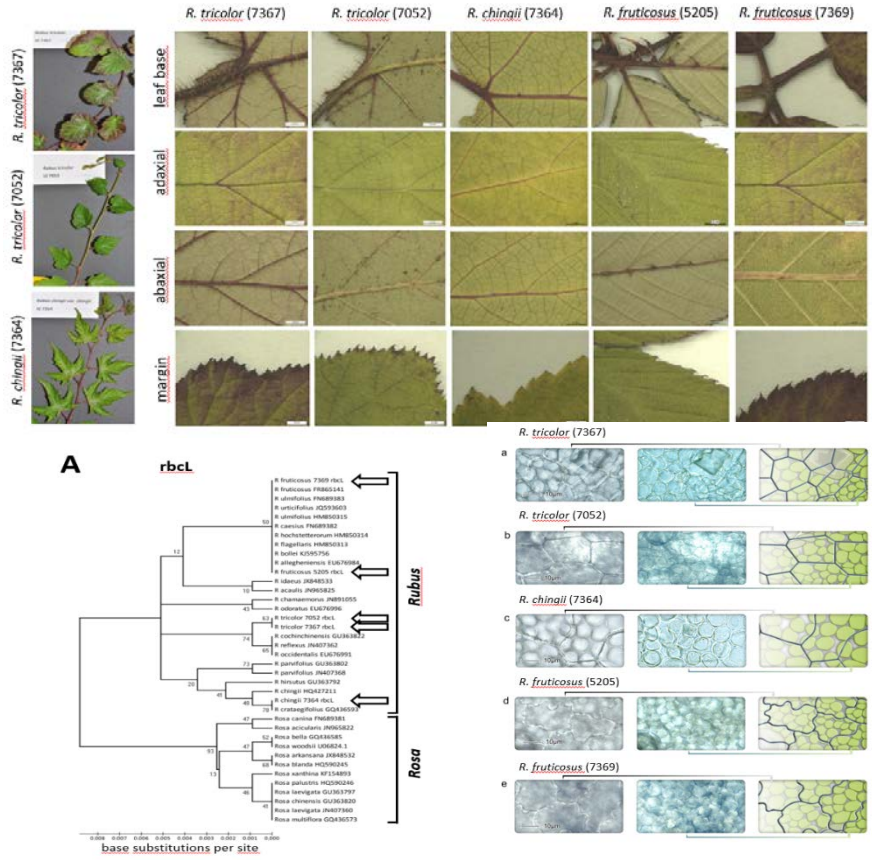
The idea of *Genetic Barcoding*

- **Vision:** Identify each species by PCR-based assays, followed by sequencing

- **Challenges:** DNA extraction (e.g. in processed samples), Authenticity of the reference – when the reference is wrong, the *barcode* is correct, but misleading!
  We cooperate with the National Reference Centre for Food Authenticity (Max-Rubner)

- **Applications:** Validate food and plant medical products, preserve biodiversity (I can only protect, what I can recognise)

4. How to safeguard consumer safety?

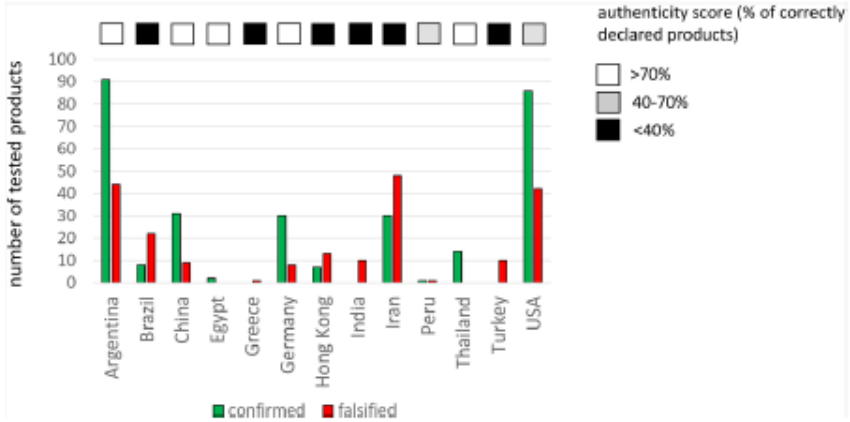


Example: Sweet Chinese Bramble

How do we proceed?

- **References:** Authenticity matters (redetermine species, exchange with taxonomy experts), find out surrogate and adulterant species. All kept as living vouchers in the Botanical Garden of the KIT.
- **Coding:** All plants get an ID that never changes: because names are volatile…
- **Data base:** morphological, microscopic-diagnostic, and genetic parameters of target species and ist surrogates and adulterants are deposited in a database.
- **Sequencing free diagnostic assays:** on base of the barcode we develop duplex-PCR fingerprints (RFLP, ARMS)

4. How to safeguard consumer safety?



frontiers in Pharmacology

MINI REVIEW
published: 09 June 2020
doi: 10.3389/fphar.2020.00876

Microscopic Authentication of Commercial Herbal Products in the Globalized Market: Potential and Limitations

Mihael Cristin Ichim[1], Annette Häser[2] and Peter Nick[2]*

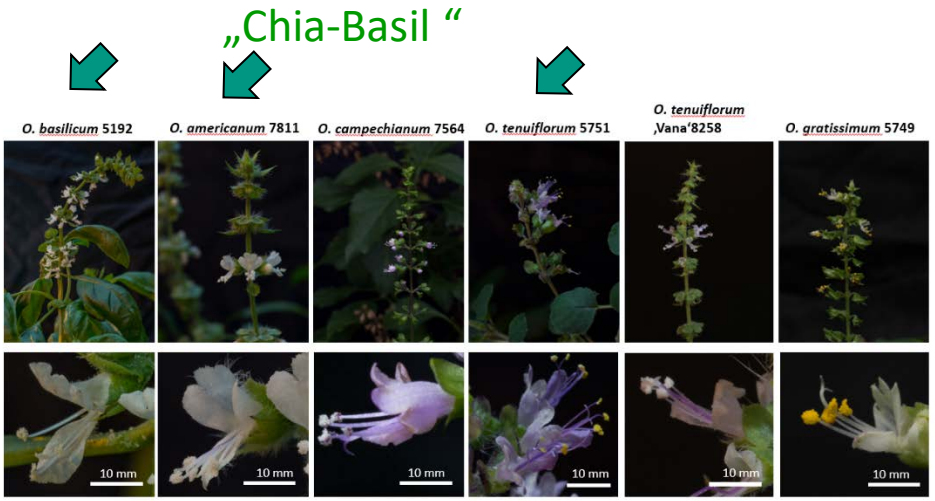
How big is the problem?

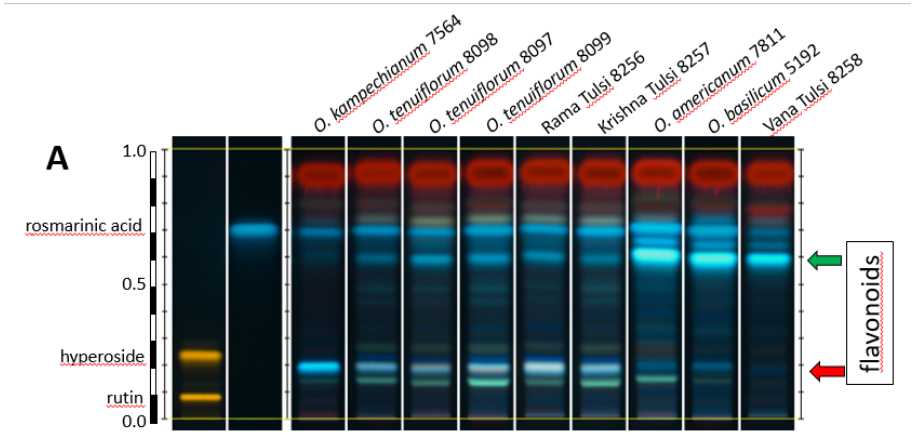
•Metastudies on authenticity

Based on microscopic diagnostics (Ichim et al., 2020): „The overall authenticity of 508 microscopically authenticated herbal products, sold in 13 countries, was **59%**, while the rest of **41%** were found to be adulterated."

Based on DNA barcoding (Ichim et al., 2019): "We analyzed data reporting the authenticity, as detected with DNA-based methods, of 5,957 commercial herbal products sold in 37 countries, distributed in all six inhabited continents. Our global survey shows that a substantial proportion (**27%**) of the herbal products commercialized in the global marketplace is adulterated."

5. Case studies: Tulsi, Chia, Goji, herbal teas

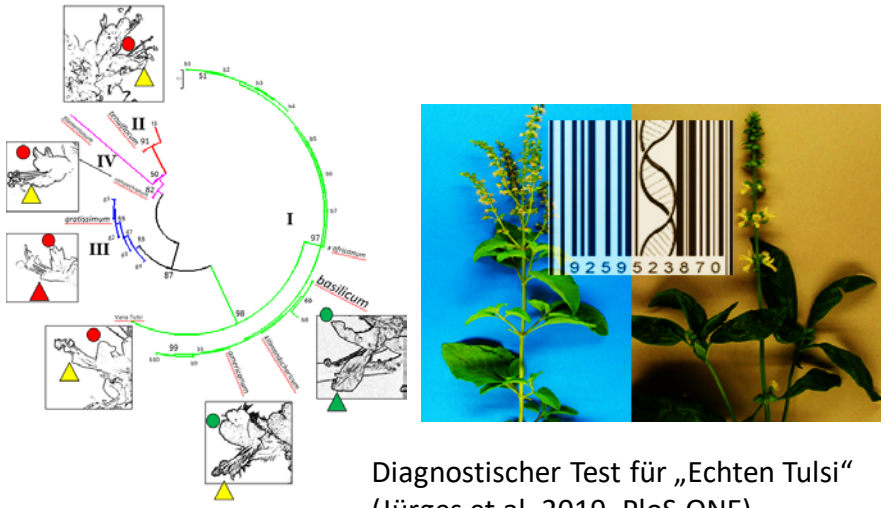




Tulsi – Holy Basil

- **Ayurveda:** „Tulsi“, the „Holy Basil“ of India was one of the first „superfoods“ that came via the UK to Europe. Depending on region and context (religion, healing, spice) different species are named as „Tulsi“.
- **Chemotypes:** Basil is rich in chemical types, e.g., eugenol, methyl-eugenol, chavicol types. Effect (and side effects!) differ.
- **„Chia“:** Since around 2015 fruits of different Basil species are sold as „Basil as Chia“, „Ocimum salvia“ or simply as „Chia“ in Smoothies. This can be toxicologically problematic (partially high estragol and methyl-eugenol contents)

5. Case studies: Tulsi, Chia, Goji, herbal teas



Diagnostischer Test für „Echten Tulsi“ (Jürges et al. 2019, PloS ONE)

How did we proceed?

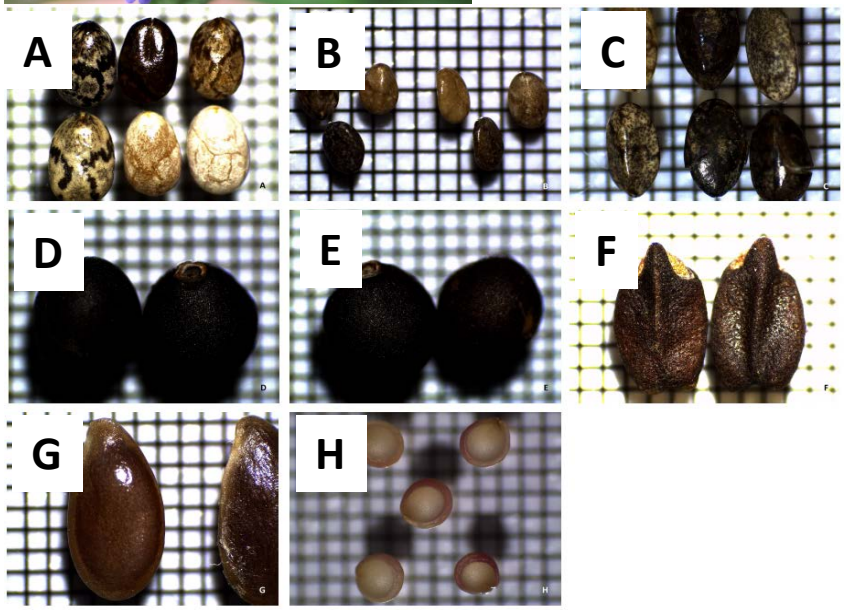
- **Molecular phylogeny:** on base of different *barcoding* sequences and validated (!) entries from GenBank we could define 4 haplotypes for Basil.

- **Restriction patterns:** for the plastidic marker *trnH-psbA intergenic spacer* we could validate base polymorphisms that produced different patterns upon restriction with Hinf I. This allowed to discern the „true“ Holy Basil (*O. tenuiflorum*) from surrogate species.

- **Surprise:** one traditional form „Vana-Tulsi“ turned out to be *O. americanum*, while „Krishna“- und „Rama“-Tulsi were *O. tenuiflorum*.

5. Case studies: Tulsi, Chia, Goji, herbal teas

The „True“ Chia:
Salvia hispanica L.



But what is „Chia“ after all?

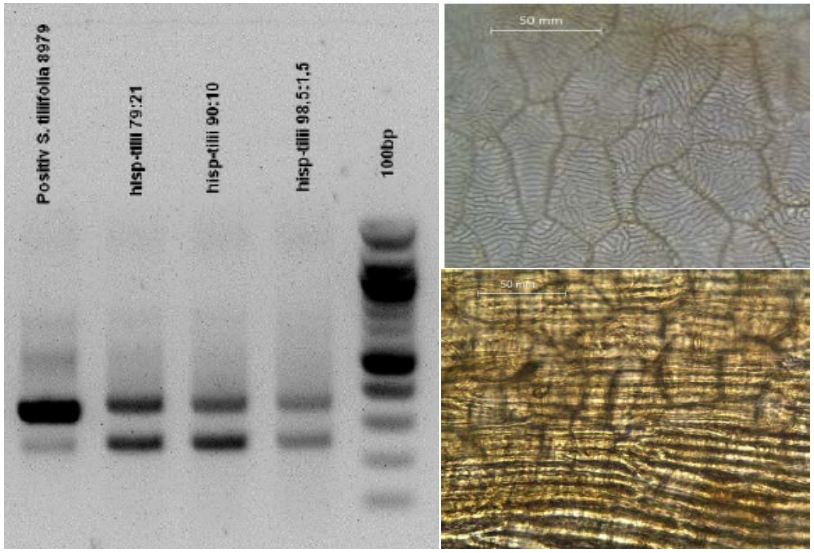
- „Chia“:= plant with oily seeds (Mexico)
- EU-Novel Food: *S. hispanica*
- 8 species are traded as „Chia“
- New: Middle East and Africa *S. aegyptiaca*
- New: Basil fruits as Chia (*Smoothies*)
- Microscopic differentiation works only partially

What is traded under the name of „Chia“:

A *Salvia hispanica* ID 8753, **B**: *Salvia tiliifolia* ID 8973, **C**: *Salvia columbariae* ID 8937, **D**: *Salvia officinalis* ID 83, **E**: *Salvia officinalis ssp. lavandulifolia* ID 8973, **F**: *Hyptis suaveolens* ID 8867, **G**: *Linum usitatissimum* ID 5182, **H**: *Amaranthus caudatus* ID 7469.

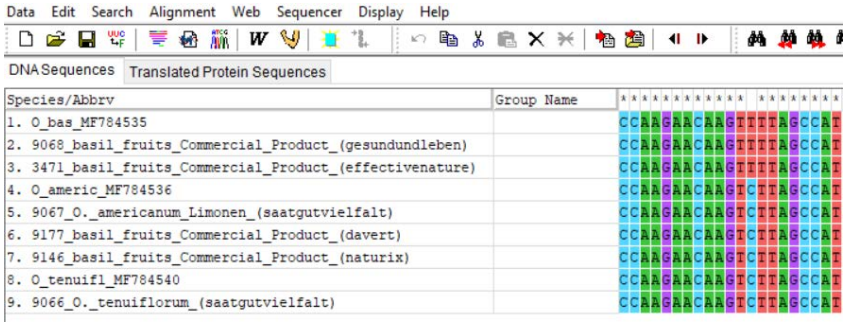
Markus Krieger 2017, Diploma thesis

5. Case studies: Tulsi, Chia, Goji, herbal teas



Method Platform for Chia Authentication

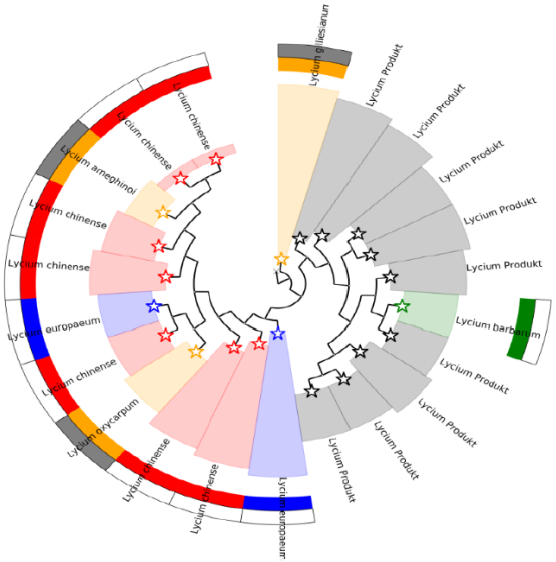
- Many species, therefore not a single test
- Molecular and microscopical diagnostics
- Fatty acid profiles are not unique
- ARMS in mixtures works
- Chia-Smoothies are actually Basil seeds
- Problem: some contain estragol (genotoxic)
- Request at producers shows full ignorance



Upper left: ARMS on base of the internally transcribed spacers allows to detect down to 1.5% admixture of *S. tiliifolia*. Upper right: microscopic diagnostics of Chia versus Lineseed. Below: identification of trnH-psbA igs from Chia-Smoothies shows *O. basilicum* and *O. americanum.*

Simon Tobias, Diploma thesis; Isabel Dörr, Diploma thesis

5. Case studies: Tulsi, Chia, Goji, herbal teas

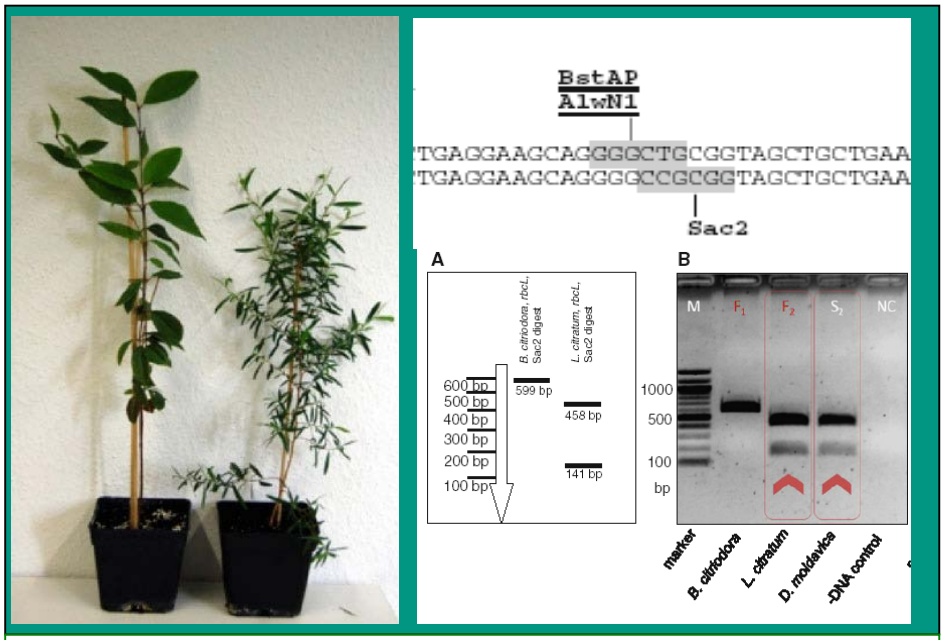


The Goji Berry

- China and Tibet debate on the nature of the "true" Goji, *Lycium chinense* versus *Lycium barbarum*.
- EU-Novel Food allows only *L. barbarum*, in China *L. chinense* is prevalent (and cheaper)
- The compounds are different, especially specific glycoproteins with anti-Alzheimer effect
- EU Novel Food warns against mix-up with "Litchii chinense" (which is pure nonsense...)
- We established a Goji collection and developed a duplex PCR (ARMS) assay.

Wetters et al., Frontiers Plant Sci., 2018.

5. Case studies: Tulsi, Chia, Goji, herbal teas



RFLP. Lemon Myrtle is a fashion plant in herbal teas („King of Lemon Scent"). Two species are traded, one is allergenic. Species show 1 SNP in the rbcL Marker. By a PCR of rbcL and digest with Sac2 a discriminative banding pattern allows to discriminate „Lemon Myrtle" (Horn et al. 2012, Eur. J. Food Sci.)

Hard Nut: Herbal teas

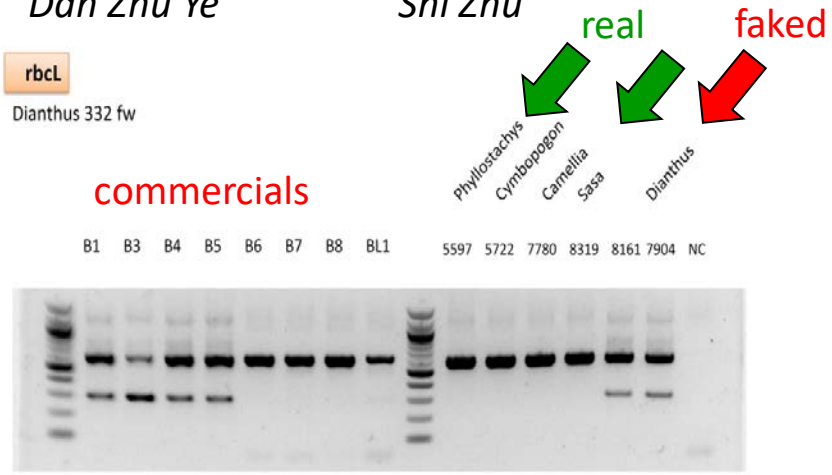
- **Why:** fast sequence of trends around individual, often exotic plants
- **Challenge:** close link to health awareness, intensive PR, partially in popular media („waiting-room effect")
- **Problem:** Plants often from traditional medical systems, names often ambiguous, local production often limited, the media hype generates rapid and high demand, profit is high – the ideal ground to cultivate adulteration!

5. Case studies: Tulsi, Chia, Goji, herbal teas

Abb. 13: *S. kurilensis*

Dan Zhu Ye

Shi Zhu



Horn et al. (2016), Peer J

Case study: Bamboo Tea

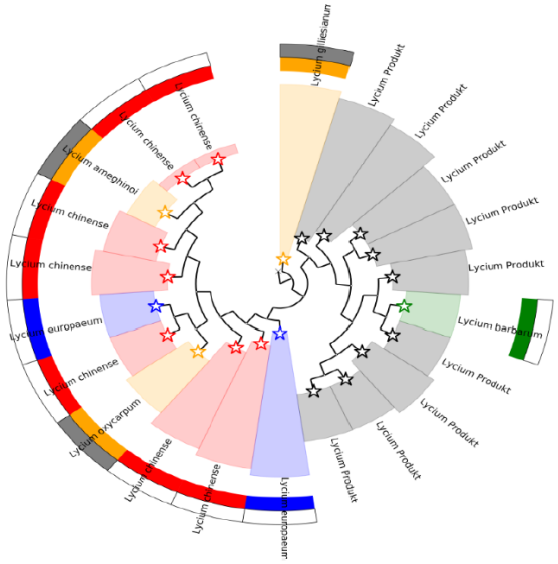
Bamboo Tea came into fashion in 2014. As *Dan Zhu Ye* 5 closely related species are used in TCM.

As „Stone Bamboo“ (*Shi Zhu*) also Chinese Carnation is used in TCM.

The boom in the West for *Dan Zhu Ye* (only two producers) depleted the market, *Shi Zhu* is also sold as *Bamboo Carnation*.

We developed a genetic fingerprint via a ARMS duplex PCR

7. What We Need



Consumer Protection Is A Joint Effort!

- Companies and consumers should be more sceptical
- Importers have to check their raw material
- Validated reference material is needed
- Integrate *genetic barcoding* into quality control rules
- Define, what quality in „Superfood“ means
- Authenticity check must become standard

Yes, we can (when we really want…)!

7. What We Need

…especially the courage to think critically and then to ask these critical questions aloud!