


BIO 235
Plants & People
Evolution & Domestication of Crops







Lecture 11 – What do we eat today?

- Food plant diversity, total, by families
- Main food plant families, the top 35 food plants
- Modern-day foragers
- Unusual food plants
- Plant parts
- What are the geographic origins of the food that we eat?
- Where is the the food we eat produced?
- Globalisation of food
- Seasonality
- Food miles
- Consumer choice

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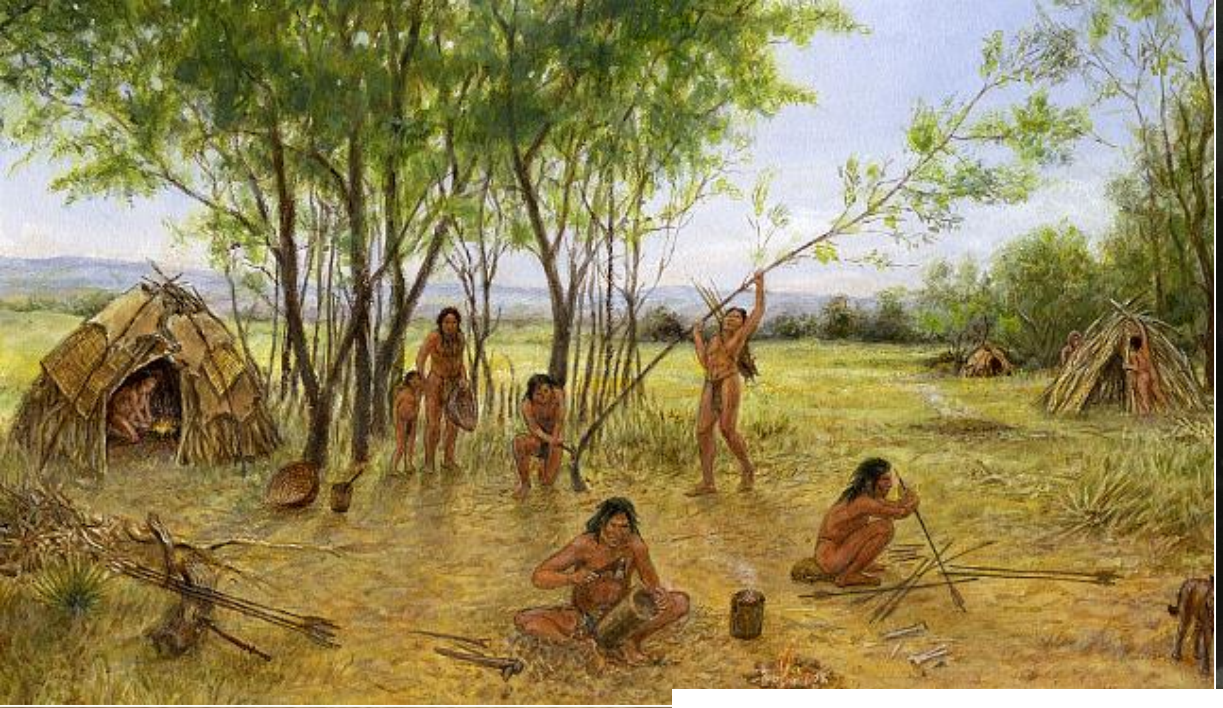


Foraging to Farming

Archaic Foraging Diet

Quercus robur
Corylus avellana

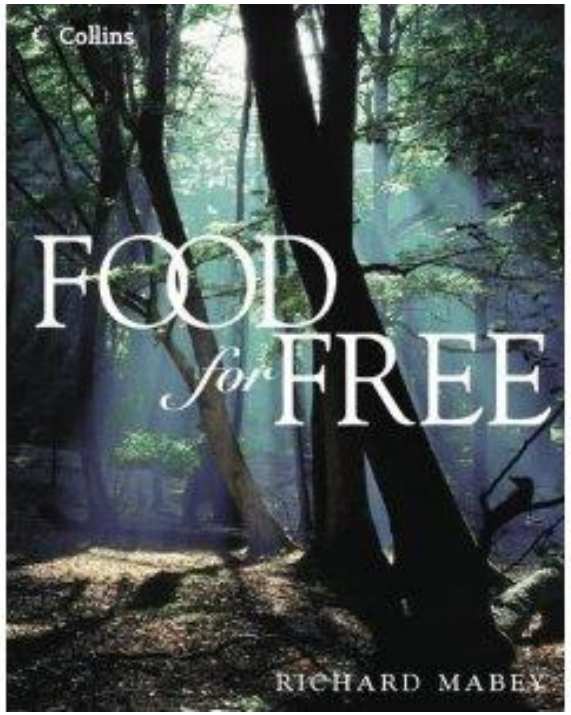
Sinapsis arvensis
Spergula arvensis

Chonopodium majus
Silverweed roots

Fungi

Chondrus crispus

Meat & fish
– e.g. Sus scrofa



Foraging

- MUSCLES - Extremely labour intensive – all available time & whole human population taken up with hunting & gathering – high calory demand & intake
- Highly seasonal
- Entirely local
- Dependent on encyclopaedic & sophisticated knowledge of plants & animals, manifest by complex systems of *folk taxonomy* and common names
- Very little choice – especially at certain times of year
- Will harvest be large enough to hold off starvation for another year?

Farming

- MACHINES - Very small fraction of people directly involved in food production (<2% in U.S.A. and still declining) – most people sedentary – reduced need for calories
- Seasonality has all but gone
- Global
- Loss of knowledge of local plants
- Endless consumer choice – spoilt rotten?
- Am I getting too fat? Too much food and its associated impacts. The advent of obesity as a larger health problem than lack of food across most of the world

Plants & People

Modern society is largely disconnected from the food they consume in terms of what species they are eating, what they look like, how they are grown, and where they come from.

What is rather striking is how unaware we are about what we are eating.

As most of us do not gather or harvest our daily food by ourselves, we often don't know which species we are eating and, if we know them, many of us would in lots of cases not even know what the plants in question looks like.

Is the relationship between plants and people shifting fundamentally???

- *You can't actually know what you are eating*
- *A big long history – I just swallow in one little bite*
- *What a big way plants have been travelling to reach my dish*
- *Everything is everywhere; only a little is as it was originally*
- *The discovery of the New World changed our diets enormously*
- *The exotic is no longer exotic*
- *Modern agriculture is close to an ecological insanity*
- *I inhaled nothing……*

Food plant Diversity

The class consumed >200 different food plant species in the space of a week.

Different individuals consumed between 13 and 100 species; mean = 53 species – these are impressive lists!

Variation may well reflect real differences in diet amongst different members of the class, but also just how thoroughly and exhaustively people recorded their food plants. Some people, included everything (all herbs, spices, flavourings), all 'hidden' ingredients, others just the main foods.

The most diverse diet, 100 plant species, was that of Till Oehen.

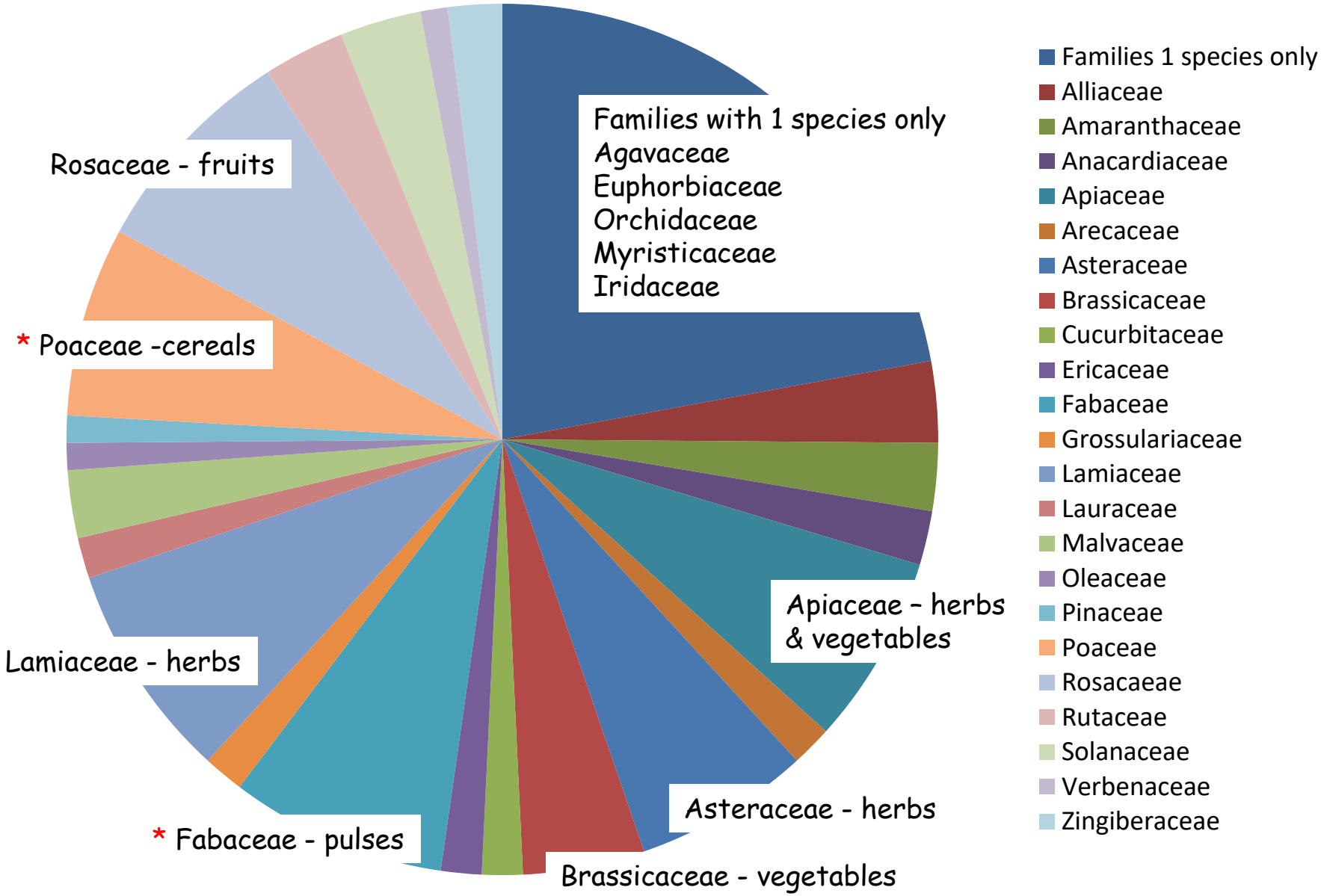
Almost all the plants we eat are Angiosperms, only 3-4 gymnosperms (e.g. pine seeds, juniper berries, ? Pine buds/shoots).

Limitations of the assignment – only lists of species, no quantitative data on amounts (grammes, calories, protein etc) of the different foods – this limits the analysis that we can do. Nevertheless, it provides an interesting snapshot of food plant diversity in Switzerland in Autumn 2018.

Class List of 200 Food Plants – pdf on OLAT

Common Name	Scientific Name	Plant Family	Origin	Number of consumers	Place of production	Plant part & Food Product
Maple syrup	Acer saccharinum	Aceraceae	North America	1	USA	Sap (phloem) from wood
Kiwi	Actinidia deliciosa	Actinidiaceae	China	3	New Zealand	Fruit
Elderberry	Sambucus nigra	Adoxaceae (Caprifoliaceae)	North temperate	3	CH	Fls, Fruit, jam, wine
Tequila	Agave tequilana	Agavaceae	Mexico	2	Mexico	Lvs (rosette), spirits
Scallion / Spring onion	Allium ascalonium	Alliaceae	W Asia	1	CH	Bulb, vegetable
Shallot	Allium oschaninii	Alliaceae	W Asia	3	CH	Bulb & Lvs
Chives	Allium schoenoprasum	Alliaceae	North temperate	9	CH, Italy	Lvs, herb
Leek	Allium porrum / A ampeloprasum	Alliaceae	Europe, Mediterranean, Middle East	9	CH, Germany, France	Lvs / shoot, vegetable
Garlic	Allium sativum	Alliaceae	central Asia	13	CH, Italy, France	Bulb - herb/vegetable
Onion	Allium cepa	Alliaceae	central Asia	16	CH, France, Germany	Bulb, vegetable
Amaranth	Amaranthus	Amaranthaceae	mexico & Andes	1	Mexico	Seed - grain
Quinoa	Chenopodium quinoa	Amaranthaceae (Chenopodiaceae)	Andes	3	Bolivia	Seed, cereal
Spinach	Spinacia oleracea	Amaranthaceae (Chenopodiaceae)	SW Asia	7	CH	Lvs, vegetable
Beetroot, Chard	Beta vulgaris	Amaranthaceae (Chenopodiaceae)	S Europe	8	CH	Root, vegetable, colourant
Sugar beet	Beta vulgaris	Amaranthaceae (Chenopodiaceae)	Europe & Asia	8	CH	root tuber - flavouring - sweetener
Brazilian pepper	Schinus terebinthifolius	Anacardiaceae	South America	1	La Reunion	Fruit, flavouring
Pistacio	Pistacia vera	Anacardiaceae	Middle East	1	USA	Seed, nuts
Marula	Sclerocarya birrea	Anacardiaceae	Africa	1	Africa	Fruit
Cashew	Anacardium occidentale	Anacardiaceae	Brazil, Caribbean	3	India, Vietnam	Seed, nuts
Mango	Mangifera indica	Anacardiaceae	India	5	Burkina Faso	Fruit
Angelica	Angelica archangelica	Apiaceae	Europe	1	CH	Lvs, shoots
Ajwain	Trachyspermum copticum	Apiaceae	India	1	India	Seeds
Asafoetida	Ferula asafoetida	Apiaceae	Iran	1	India	phloem from root
Dill	Anethum graveolens	Apiaceae	Europe	2	CH	Lvs, herb
Aniseed	Pimpinella anisum	Apiaceae	Mediterranean	3	Spain	Seed, spice
Caraway	Carum carvi	Apiaceae	Fertile Crescent	3	Middle East	Seed
Parsnip	Pastinaca sativa	Apiaceae	Europe	4	CH, Hungary	Root

Food Plant Diversity by Plant Families – 63 families in total



Poaceae = Cereals = Grasses

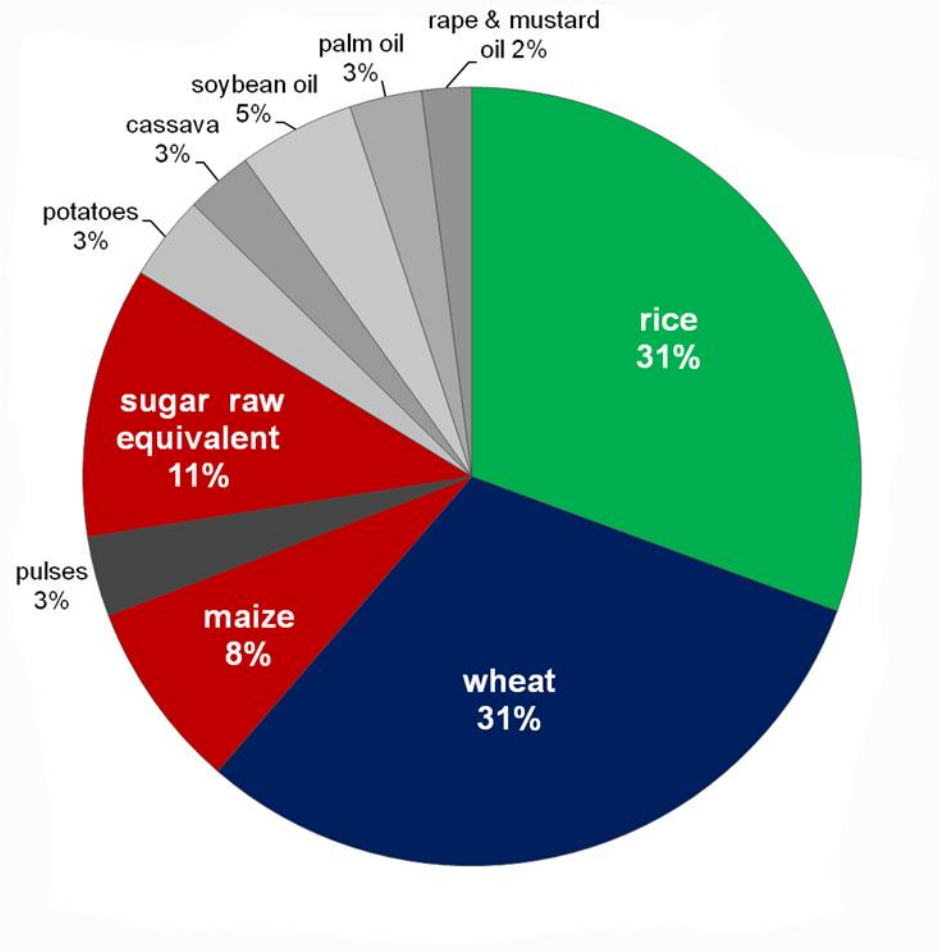
Grass domestication of unique importance in the history of human civilizations, providing the main staple foods for the majority of the world's population

The world's three top food crops are grasses:

Maize, *Zea mays*
Mesoamerica

Wheat, *Triticum spp.*
Fertile Crescent

Rice, *Oryza sativa*
S.E. Asia



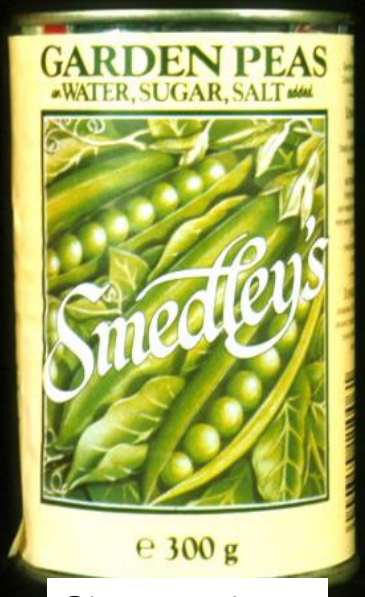
FAO 2009: global consumption of 10 major vegetal foods (2003-2005)

Fabaceae - Pulses

Edible, highly nutritious staple food crops with high crude protein contents

Phaseolus vulgaris

Lens culinaris



Pisum sativum

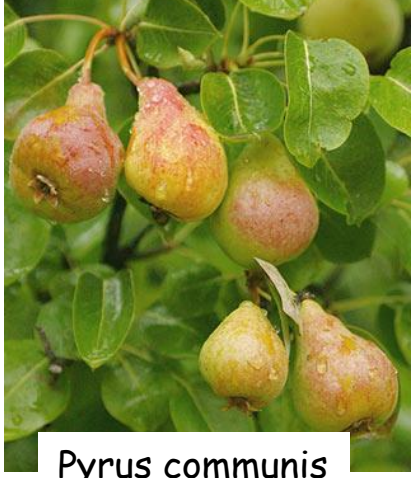
Cicer arietinum

Glycine max

Arachis hypogaea

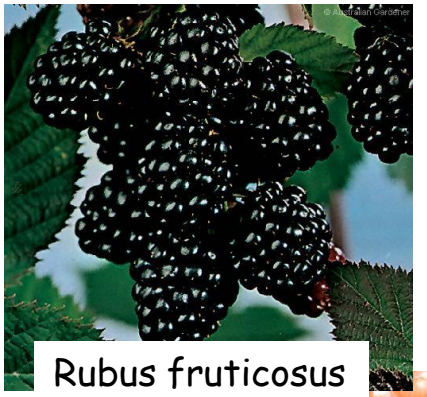
Rosaceae Many seasonal fruits


Aronia melanocarpa


Pyrus communis


Malus domestica


Prunus armeniaca


Rubus fruticosus


Prunus dulcis

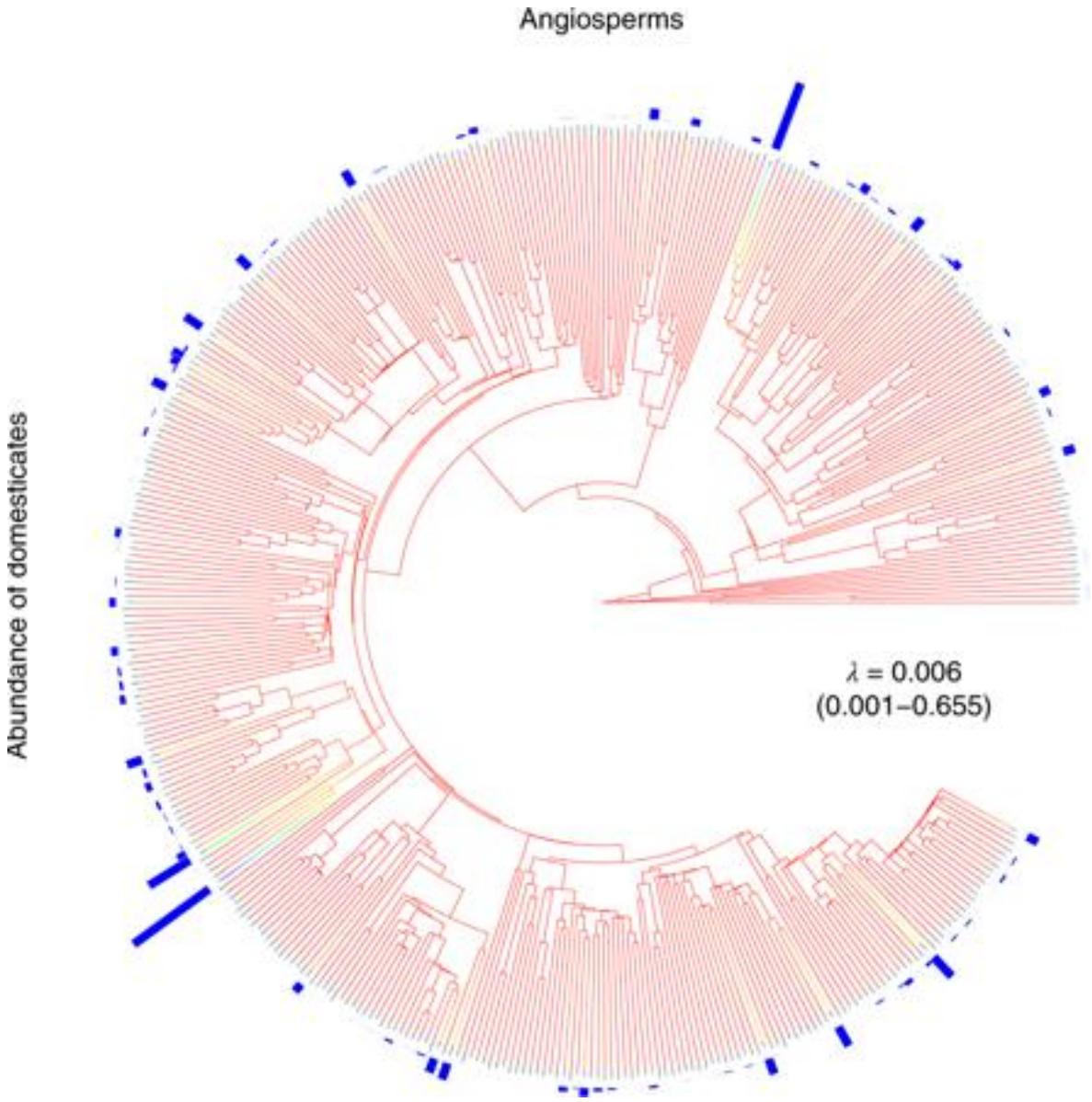

Prunus avium


Prunus domestica


Fragaria xananassa


Rubus idaeus

Phylogenetic distribution of crops across Angiosperms



370,000 species of Angiosperms

1,000-2,000 some form of domestication

120 families

453 genera

Poaceae, Leguminosae & Solanum

Milla et al. (2018)

Phylogenetic distribution of livestock across Mammals

5,400 species of Mammals

20-31 some form of domestication

22 genera

Bovidae = 40%

Milla et al. (2018)

Lamiaceae – An important plant family with 15 species on our combined list, but these only important as herbs and flavourings because their leaves are often rich in essential oils, many of these species from the Mediterranean and typical of the Mediterranean maquis vegetation

Mentha (mint, peppermint)
Melissa (lemon balm)
Thymus (thyme)
Salvia (common sage, clary sage)
Rosmarinus (rosemary)
Nepeta (catnip)
Ocimum (basil)
Origanum (oregano, marjoram)
Satureja (savory)
Hyssopsis (hyssop).

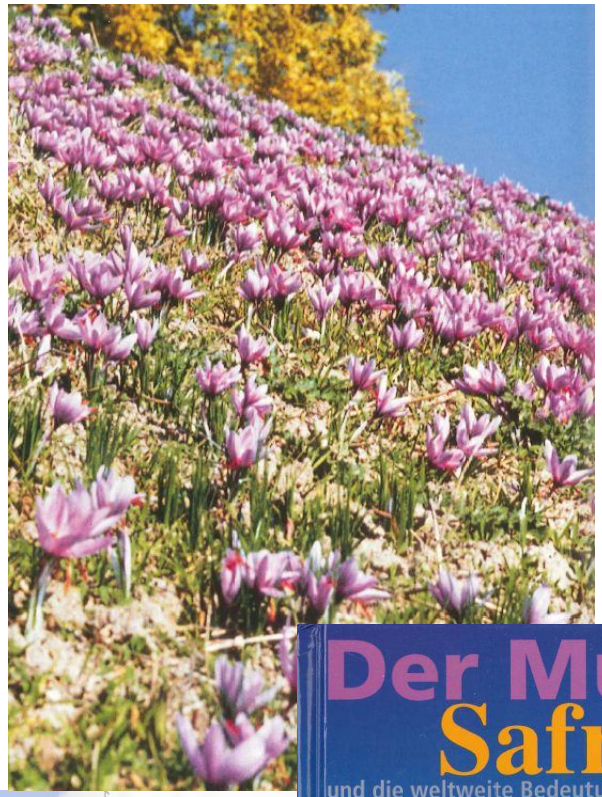
Spices

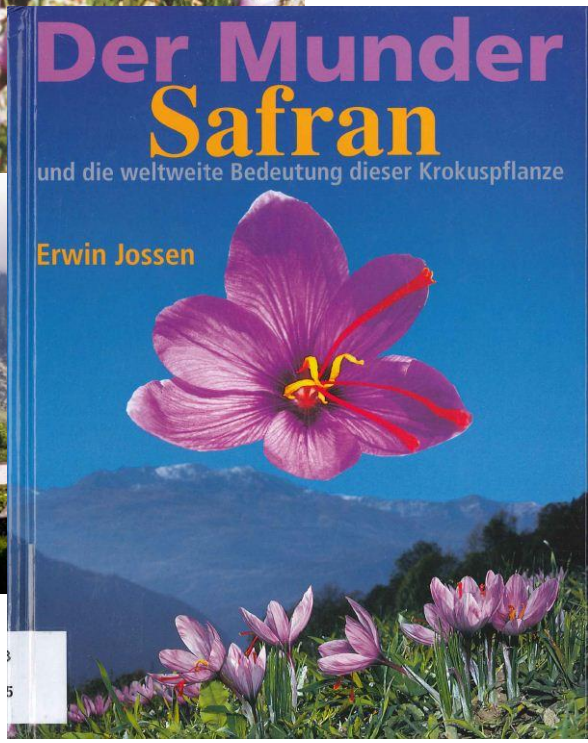
Ginger – Zingiber – Zingiberaceae - rhizome
Saffron – Crocus sativa – Iridaceae – stigma & style of flower
Pepper – Piper nigrum – Piperaceae – fruit
Cinnamon – Cinnamomum vernum – Lauraceae – bark
Nutmeg – Myristica fragrans – Myristicaceae – seed or aril (mace)
Cloves – Syzigium aromatica – Myrtaceae – dried flower buds
Green Cardamon – Elettaria cardamomum – Zingiberaceae - seed
.....

Diverse plant families
Diverse plant parts

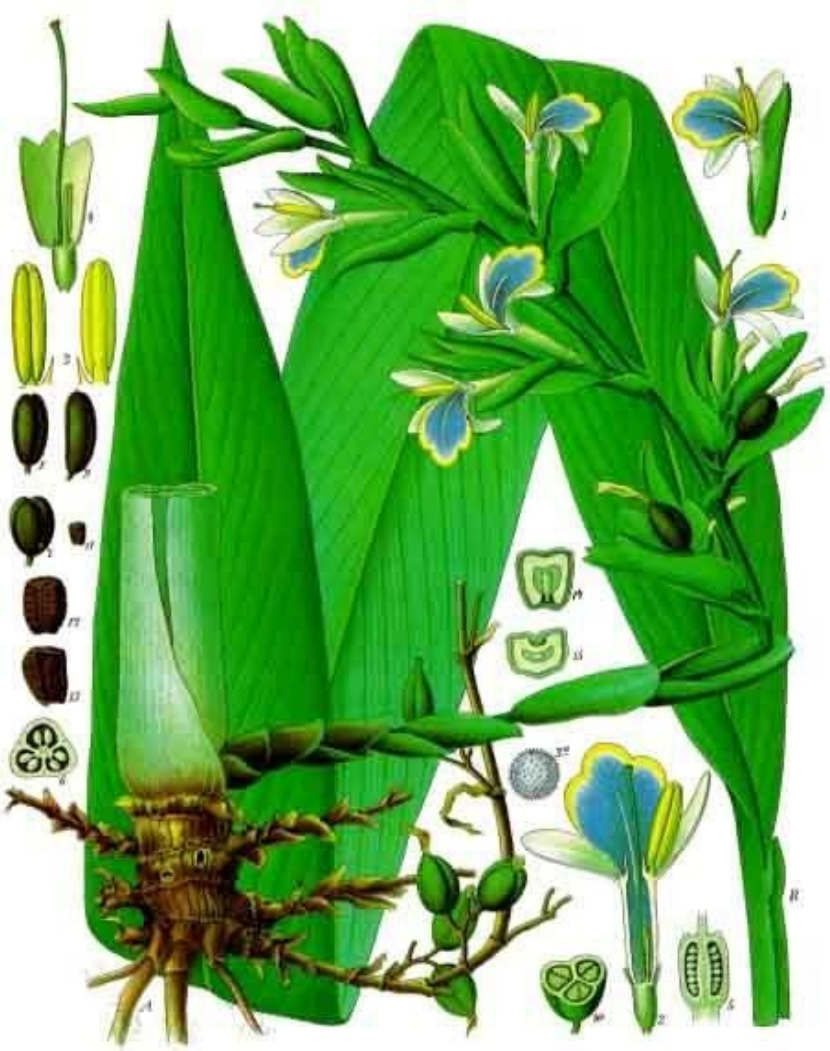
Saffron /Crocus sativus / Iridaceae / stigma & style / Turkey / Mund?? (CH)

The world's most costly spice by weight – a few kg in Mund each year





Cardamon

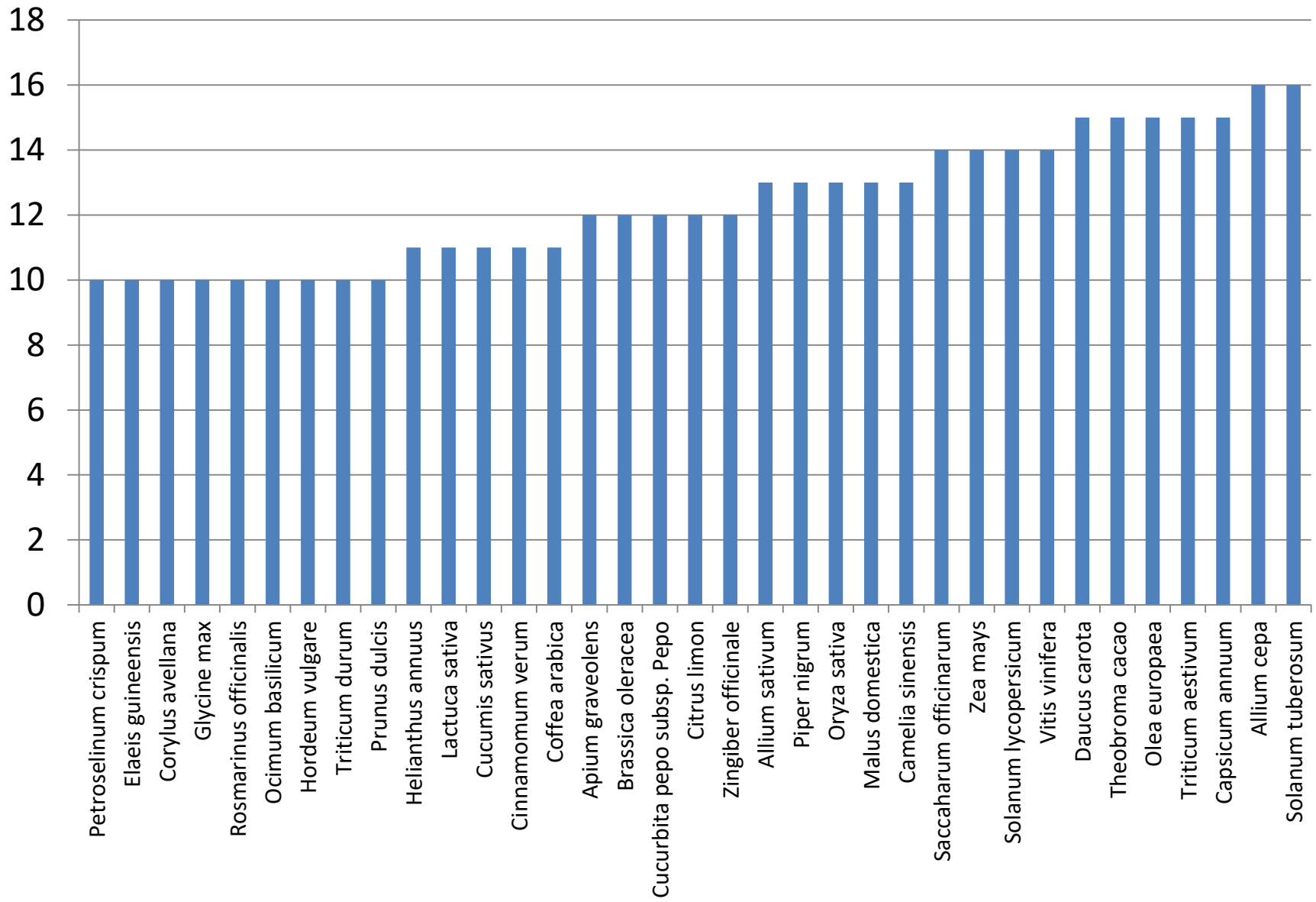


Zingiberaceae

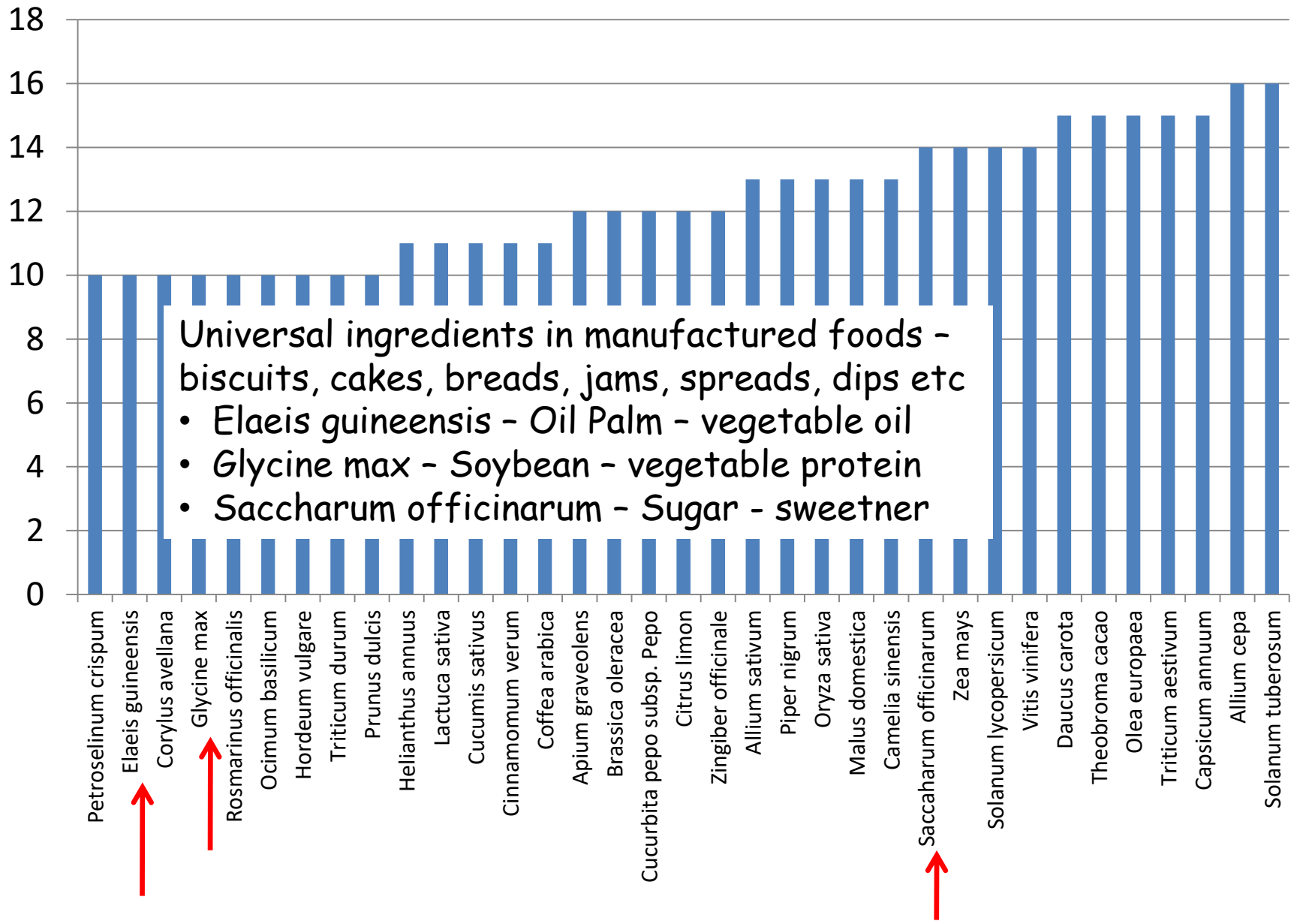
Elettaria cardamomum = green or true cardamon from India & Malaysia

Amomum = black cardomum from Asia / Australia
-*Amomum subulatum* – Indian cuisine
-*Amomum costatum* – Chinese cuisine

The Top 35 Food Plants



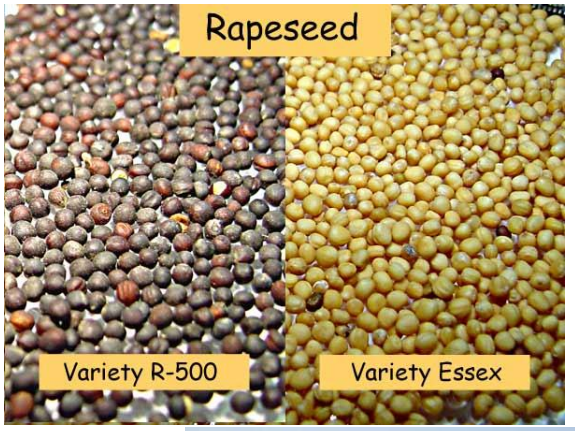
The Top 35 Food Plants



Hidden plant ingredients
Cooking Oil

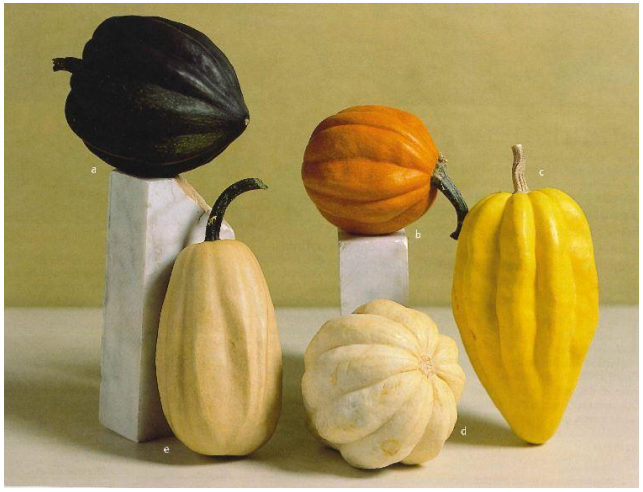
Olive oil
Olea europaea
Oleaceae

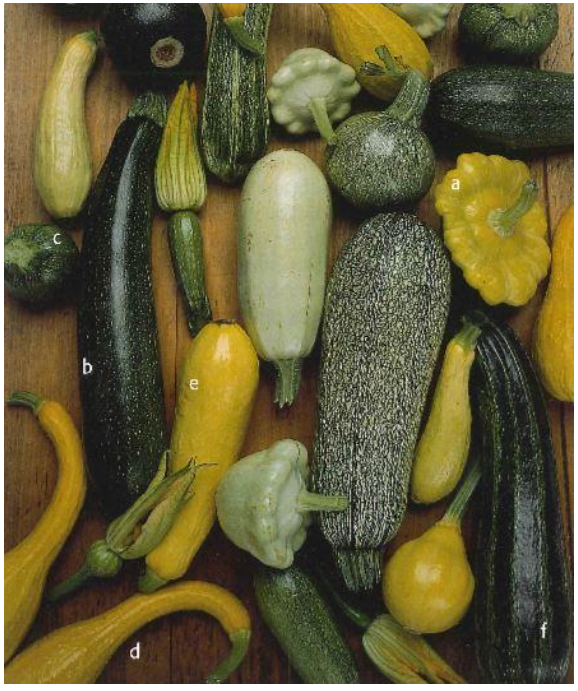
Oil seed rape
Brassica napus
Brassicaceae



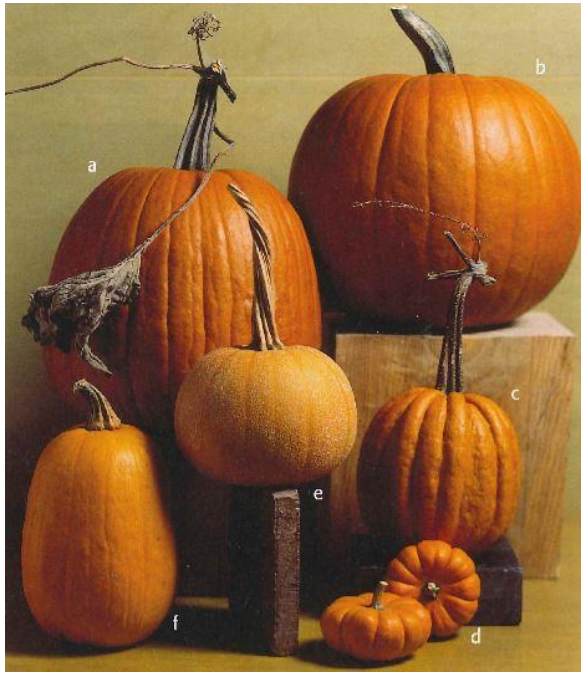
Oil palm, Elaeis guineensis, Aracaceae

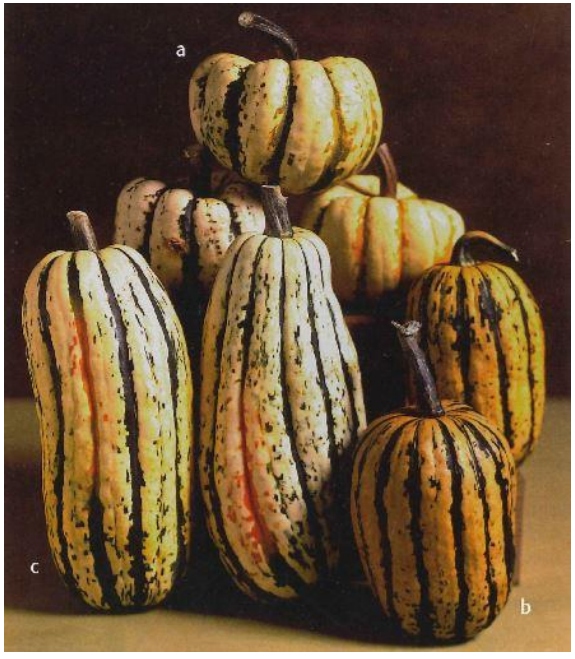
Sunflower oil
Helianthus annua
Asteraceae

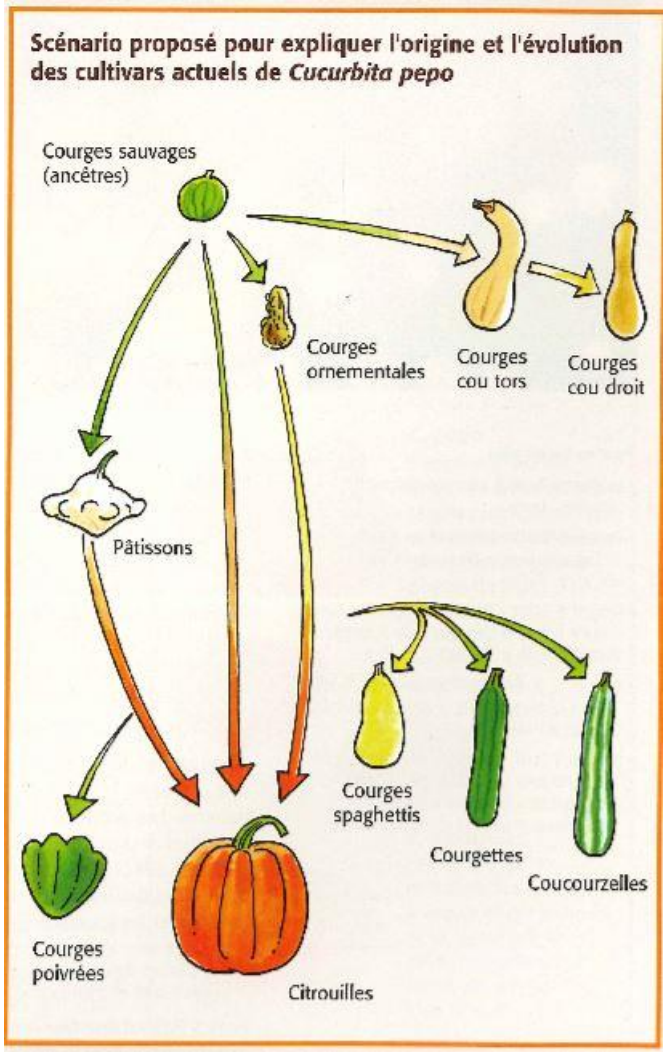




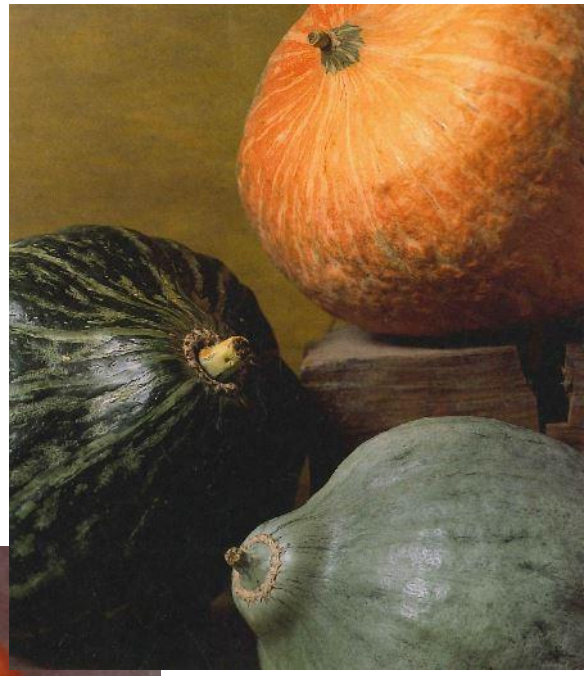
Cucurbita pepo

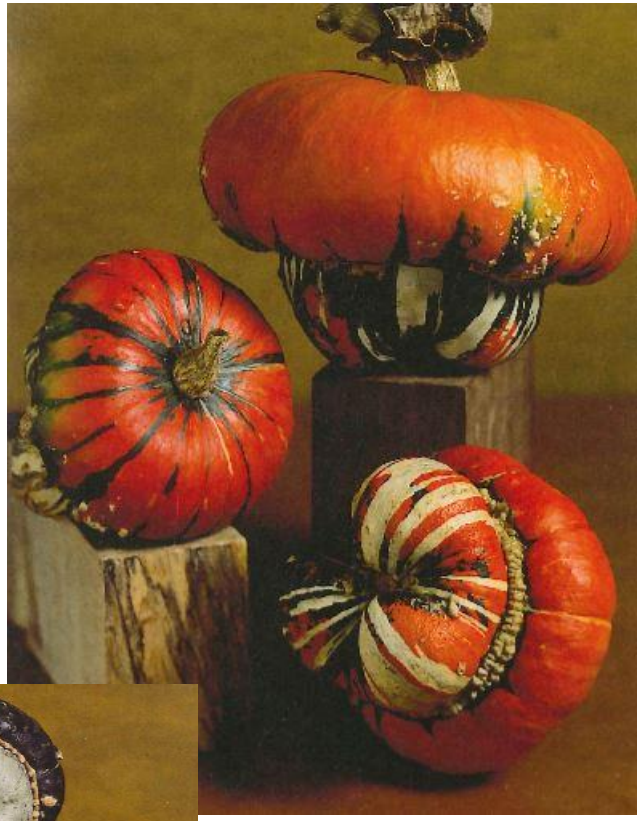


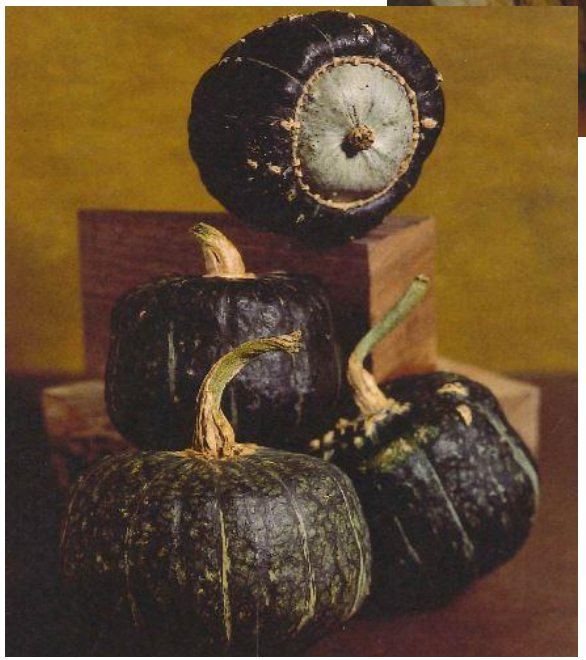




Cucurbita maxima

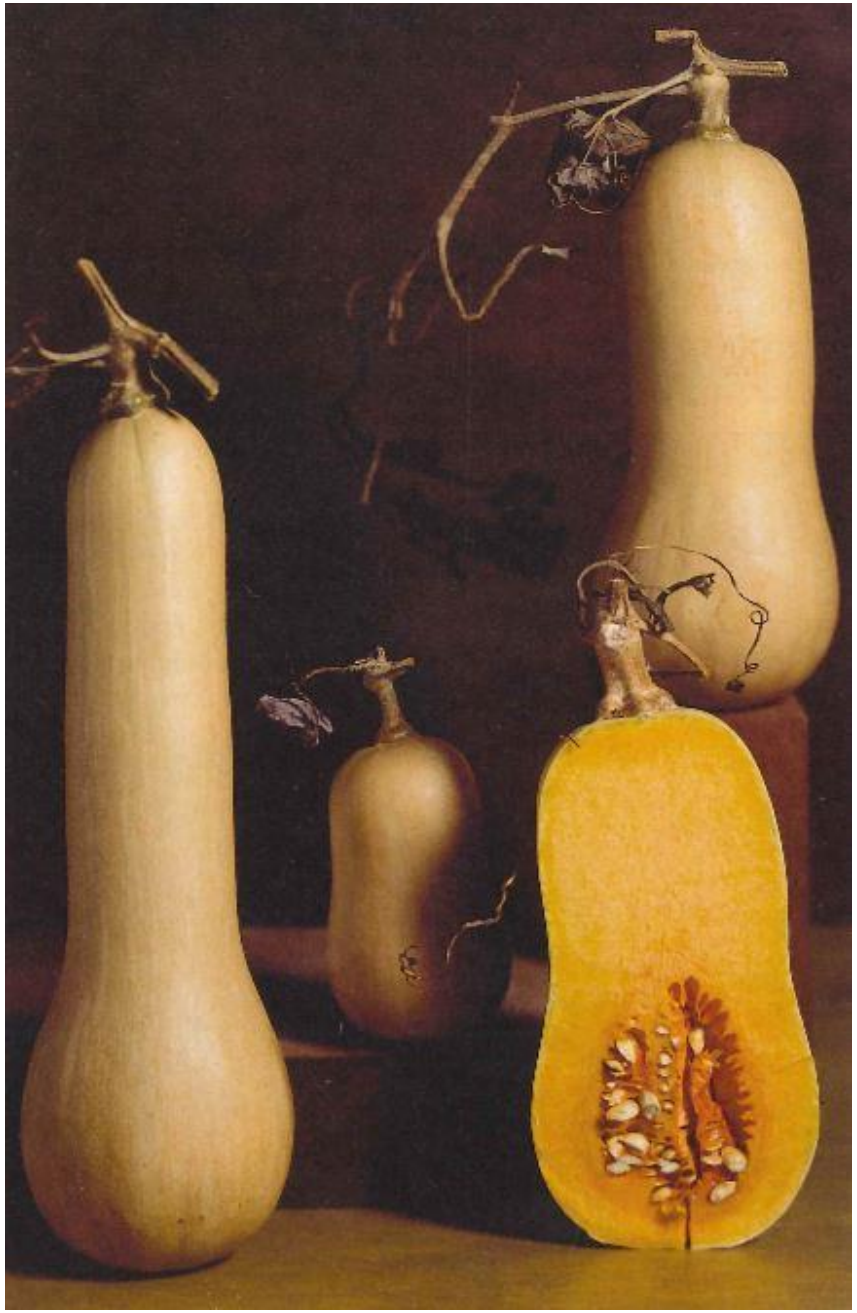






Cucurbita maxima – up to 850kg

Cucurbita moschata



Blueberries

Vaccinium macrocarpon – American cranberry – eastern Canada – cultivated, but not domesticated

Vaccinium oxycoccos - small cranberry – north temperate, incl. Europe – harvested in the wild

Vaccinium corymbosum – blueberry (huckleberry) – North America – domesticated – the most widely cultivated blueberry

Vaccinium vitis-idaea - lingonberry – north temperate, boreal & tundra – harvested in the wild

Vaccinium myrtillus – bilberry (blueberry) – north temperate – harvested in the wild – the most common species harvested in Europe

Vaccinium macrocarpon
Cranberry – Wisconsin, U.S.A.
Juice & dried fruits

Vaccinium corymbosa
Blueberry – Quebec, Canada
Fruits

Modern-Day Foragers

Not all foods come from domesticated plants. Even in western societies, some people are still part time foragers. Examples of food plants on your lists that were foraged from wild or from cultivated but undomesticated or incipiently domesticated species:

Bilberry, Vaccinium myrtillus
Chestnut, Castanea sativa
Elderberry, Sambucus nigra
Rose Hip, Rosa canina
Hazel, Corylus avellana
Blackberry, Rubus fruticosus
Nettle, Urtica dioica
Ground elder, Aegopodium podagraria
Hawthorn, Cretaegus monogyna
Yew, Taxus baccata

BIO-Herb Bread

Fennel – Foeniculum vulgare

Edelweiss
Leontopodium sp.

Pot marigold
Calendula officinalis

Cornflower, Centaurea cyamus

Hyssop
Hyssopus officinalis

Lemon balm
Melissa officinalis

The Botanical Society of Scotland in 2013 set up a competition for the Christmas cake recipe with the most species of plant among its ingredients – the winning recipe contained 127 species in 54 plant families.

blackcurrant, orange mint, sage, lemon, cranberry, sea buckthorn, elder flower, cherry, mint, lemon verbena, eucalyptus, apple mint and mountain mint..... > 12 species

Honey??

Appenzeller Alpenbitter

42 herbs, spices, flowers and roots

In the 1800s, a pharmacist in the U.S.A., John Penberton took extracts of kola and coca and mixed them with sugar, other ingredients, and carbonated water to invent the first cola soft drink. His accountant tasted it and called it 'Coca-Cola'. The epitomy of globalisation: harnessing ingredients globally & consumed globally

Coca leaves – *Erythroxylum coca* - Andes

& nutmeg (Indonesia), coffee (Ethiopia), vanilla (Mexico), cinnamon (S Asia)

Kola nuts – *Cola acuminata* - Cameroon

Sugar - *Saccahrum officinalis* – SE Asia

Chinin – Cinchona pubescens bark

Rhubarb – Rheum rhubarbarum - petiole

Pomegranate – Punica granatum - fruit

Ginseng – Panax ginseng - root

Orange – Citrus sinensis - fruit

Cascarilla – Croton eluteria - bark

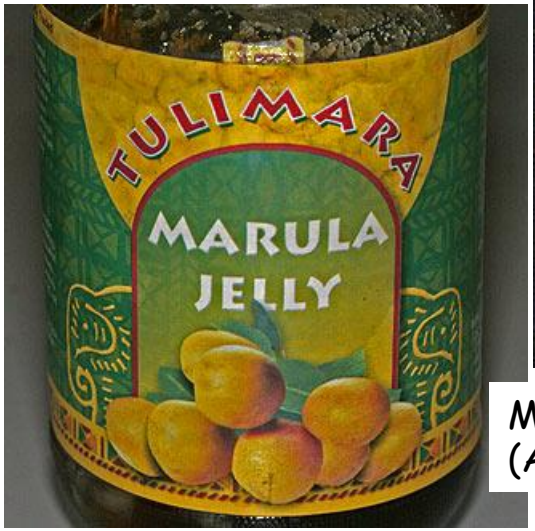
Toffifee Sweets

Oil Palm – Elliaeus guineensis

Illipe fat – Shorea robusta - Dipterocarpaceae

Shea butter – Vitellaria paradoxa Sapotaceae

Soya bean – Glycine max - Fabaceae



Marula, Sclerocarya birrea (Anacardiaceae) from Africa

Rama Tulsi / Vana Tulsi, Ocimum sanctum & O. gratissimum (Lamiaceae), herbal teas from India

Sweet Leaf - Stevia rebaudianae, (Asteraceae) from South America – leaves used as sweetner

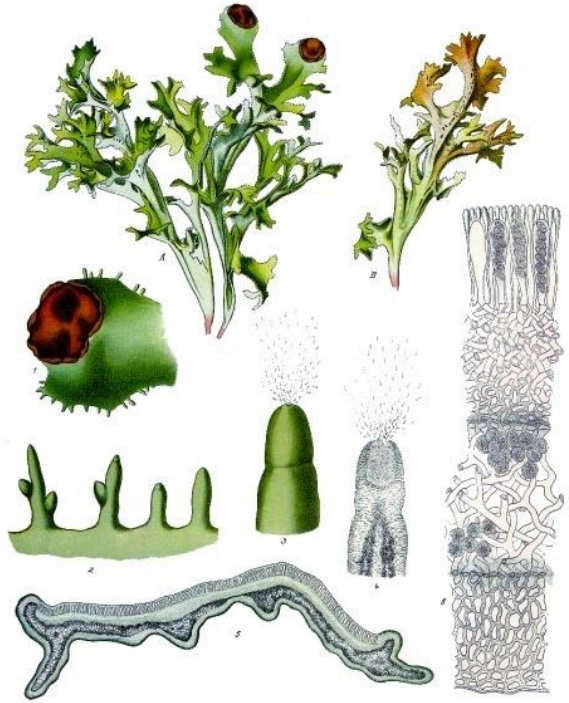
Marsh mallow, Althaea officinalis (Malvacaeae) from Egypt

Carob, *Ceratonia siliqua* (Leguminosae) – pods, sugar substitute, gum

Wakame, *Undaria pinnatifida* (Alariaceae) – leaves – miso soup

Okra, *Abelmoschus esculentus* (Malvaceae) – fruits from Asia

Pink peppercorn, *Schinus molle* – (Anacardiaceae) – fruits from S. America



Iceland moss – *Cetraria islandica* (Parmeliaceae) a lichen – whole plant consumed N hemisphere boreal

Jiaogulan – *Gymnostemma pentaphyllum* – Cucurbitaceae – leaves – a powerful antioxidant

Agave nectar – *Agave tequilana* / *A. salmiana* – Agavaceae – a syrup sweeter than honey - Mexico

Safflower oil – *Carthamnus tinctorius* – Asteraceae – Mediterranean – vegetable oil from seeds

Maca – Lepidium meyenii – Brassicaceae - Peru

Goji berries – Lycium barbanum - Solanaceae

Latex, gums and sugar sap

Chicle – Manilkara chicle – Mexico & Belize

Gum Arabic – Sengalia (Acacia) senegal - Sudan

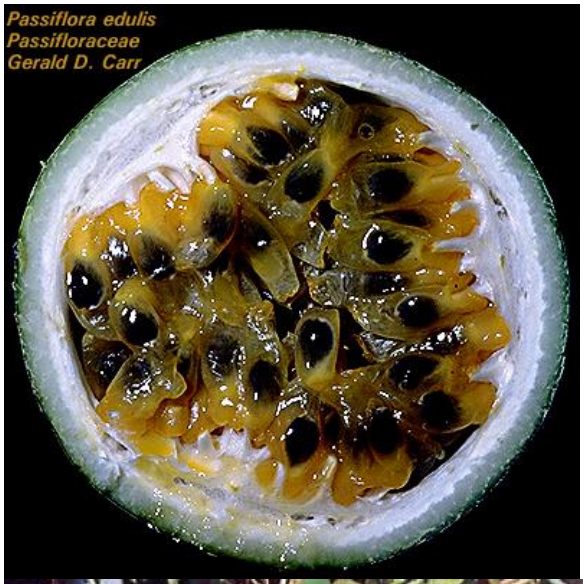
Maple syrup – Acer saccharum - Canada

Chewing Gum

Chicle – Manilkara chicle

Carnauba Palm wax
Copernia prunifera

Bark of
Cherry birch
Sweet birch
Betula lenta



Passion fruit
Passiflora edulis
Passifloraceae

Multi-fruit (tropical) drinks

Papaya
Carica papaya
Caricaceae

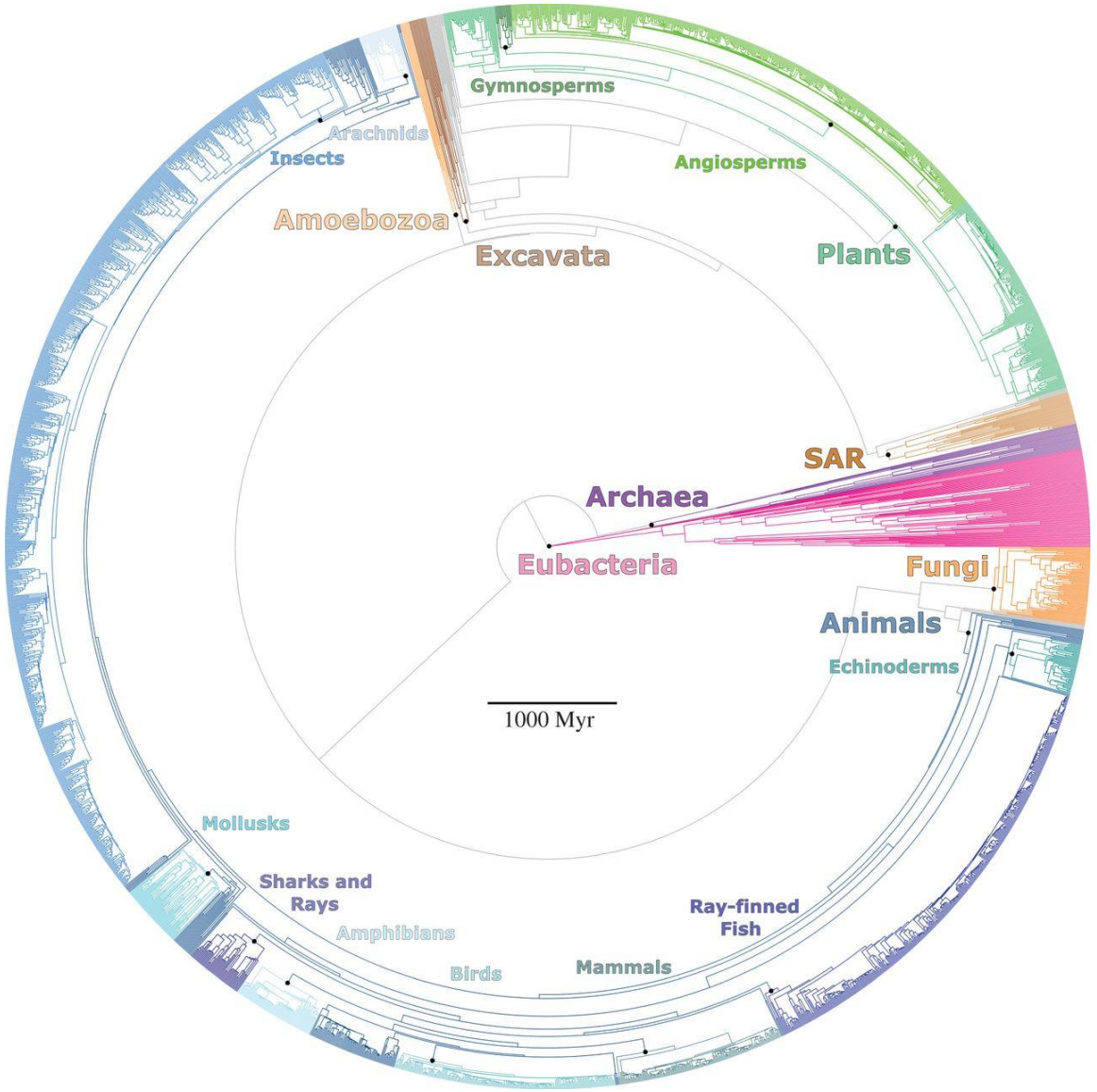
Mango
Mangifera indica
Anacardiaceae

Persimmon
Diospyros kaki
Ebenaceae

Agaricus and Boletus Mushrooms

Are these plants?

Fungi are more closely related to animals that they are to plants



Food Plant Diversity

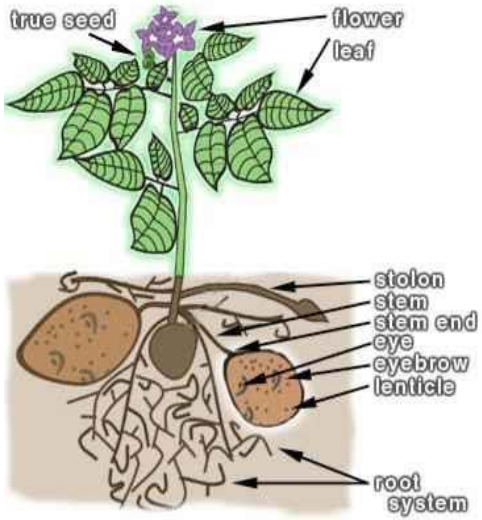
Most people seemed surprised how diverse their food intakes were, BUT, only represents <1% of the 350,000 Angiosperm species – an incredibly small percentage.

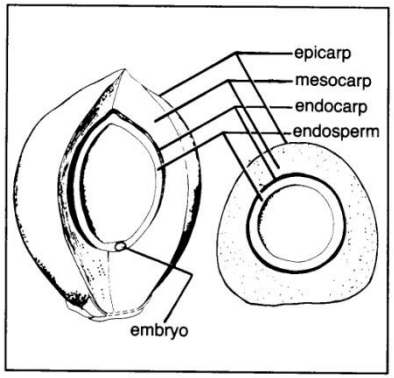
Approximately 200 species have been fully domesticated worldwide, up to 2,000 used and domesticated to some degree.

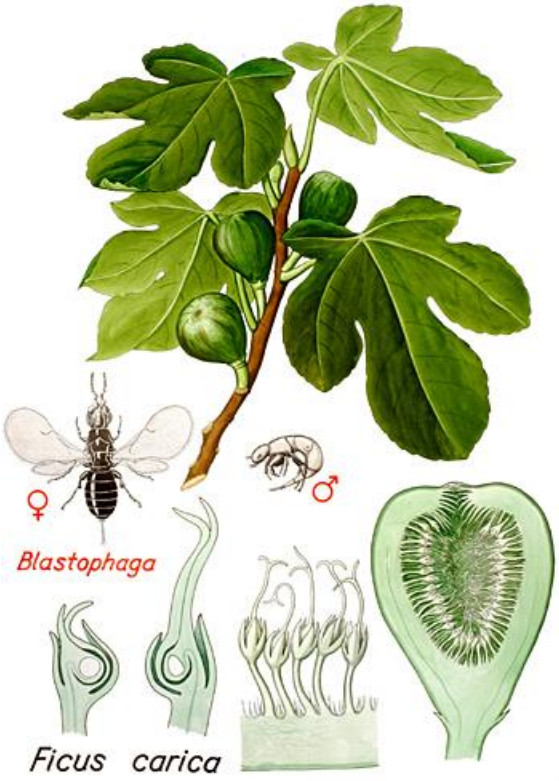
Fewer than 20 crops in 8 families provide 90% of the world's calories: wheat, rice, maize, beans, sugarcane, sugar beet, cassava, potato, banana, coconut, soybean, peanut, barley and sorghum.

Most of the food plant species that we consume are minor ingredients used to add flavour, with little or no nutritional value.

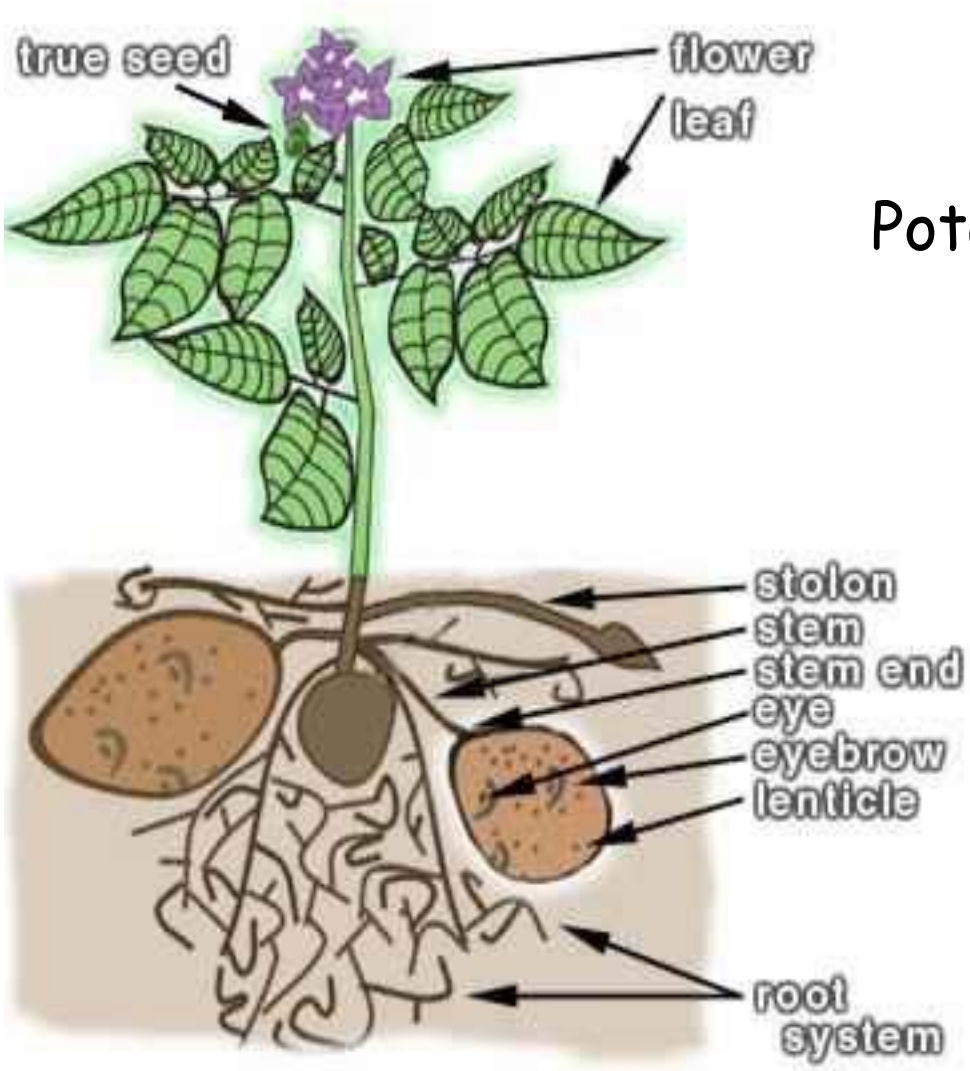
Plant Parts


true seed
flower
leaf
stolon
stem
stem end
eye
eyebrow
lenticle
root system

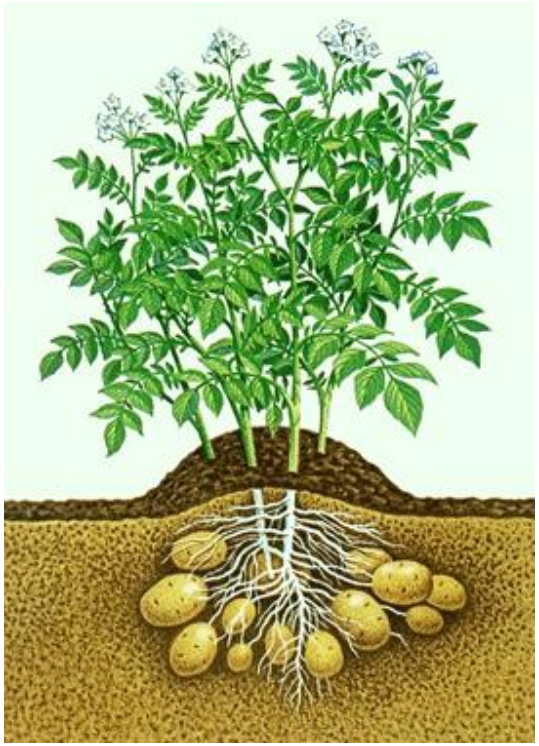

epicarp
mesocarp
endocarp
endosperm
embryo


♀
♂
Blastophaga
Ficus carica

Plant Parts



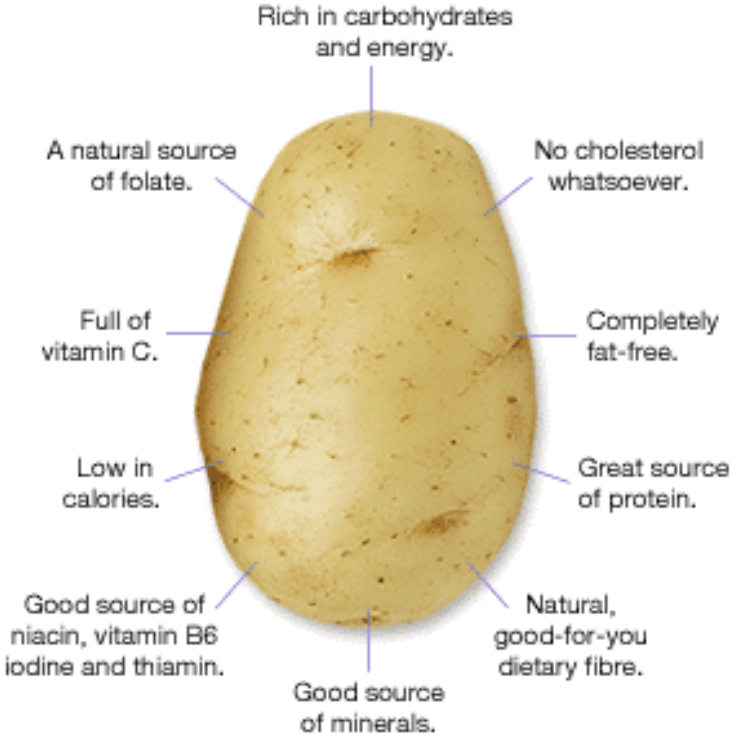
Potato = stem tuber



Plant Parts

Onion = bulb (condensed leaf bases)

Garlic = bulb (condensed leaf bases)


Rich in carbohydrates and energy.
A natural source of folate.
No cholesterol whatsoever.
Full of vitamin C.
Completely fat-free.
Low in calories.
Great source of protein.
Good source of niacin, vitamin B6 iodine and thiamin.
Natural, good-for-you dietary fibre.
Good source of minerals.

Plant Parts

Celeriac = hypocotyl
Apium graveolens var. *rapaceum*

Celery = petiole
Apium graveolens var. *dulce*

Fennel = petiole

Plant Parts

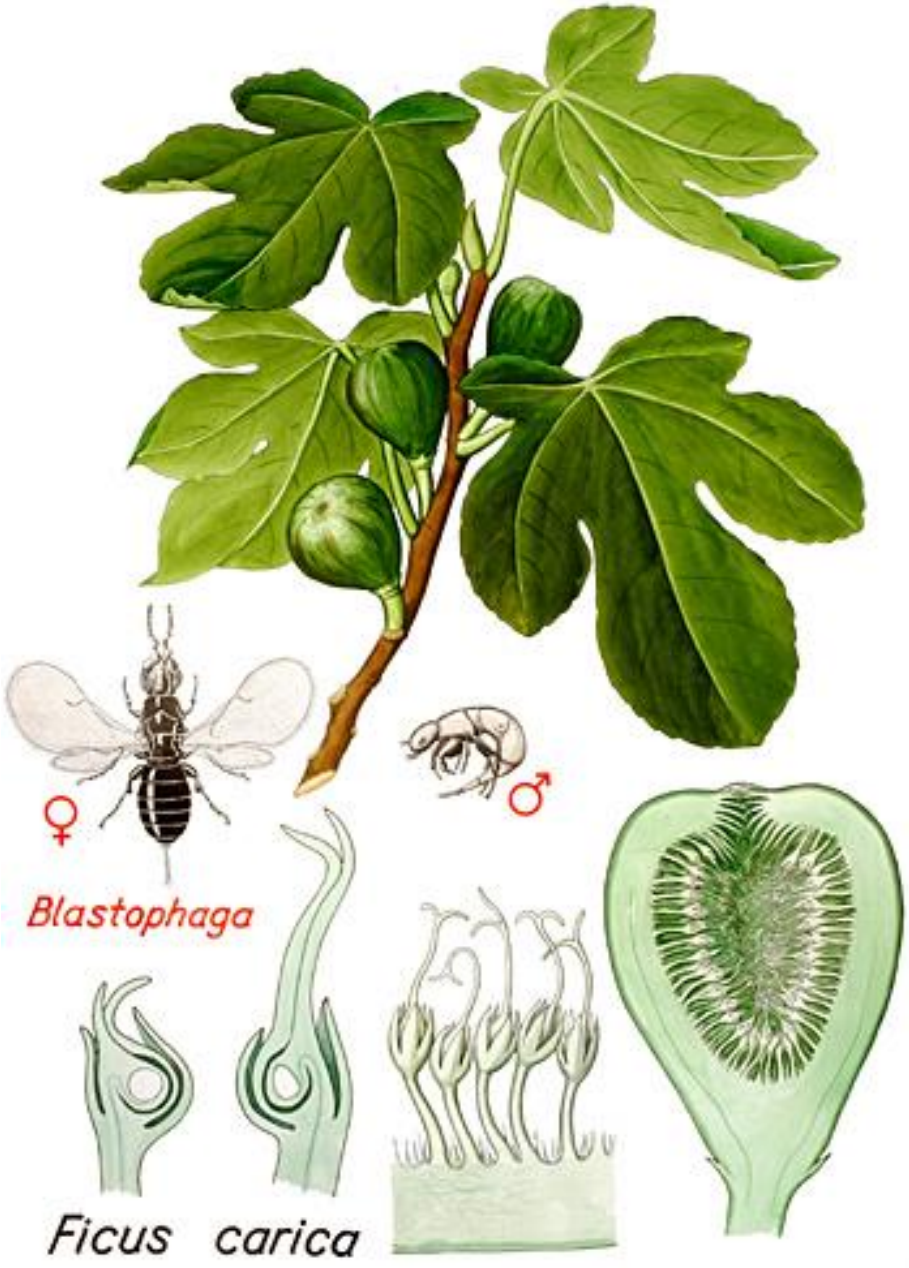
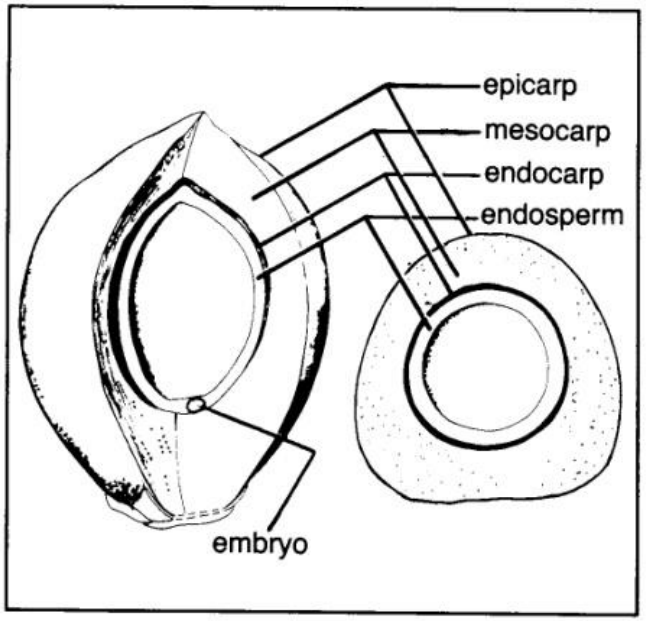


Fig = inflorescence (syconium)

Plant Parts



Coconut = endosperm

Plant Parts

Artichoke
Floral bracts
Involucre of capitulum (inflorescence)

Cashew = seed
Real fruit = drupe
Seed surrounded by allergenic resin, anacardic acid, an important skin irritant – which is why cashews are roasted

Accessory fruit = swollen pedicel (flower stalk)

Pineapple

condensed accessory compound fruit made up of many fused fruits on an inflorescence

Bean sprouts

Cress – Lepidium (Brassicaceae)
Hypocotyl & cotyledons

Mung bean – Vigna (Fabaceae)
Seed & root / hypocotyl

Nutmeg

Myristica fragrans
Myristicaceae

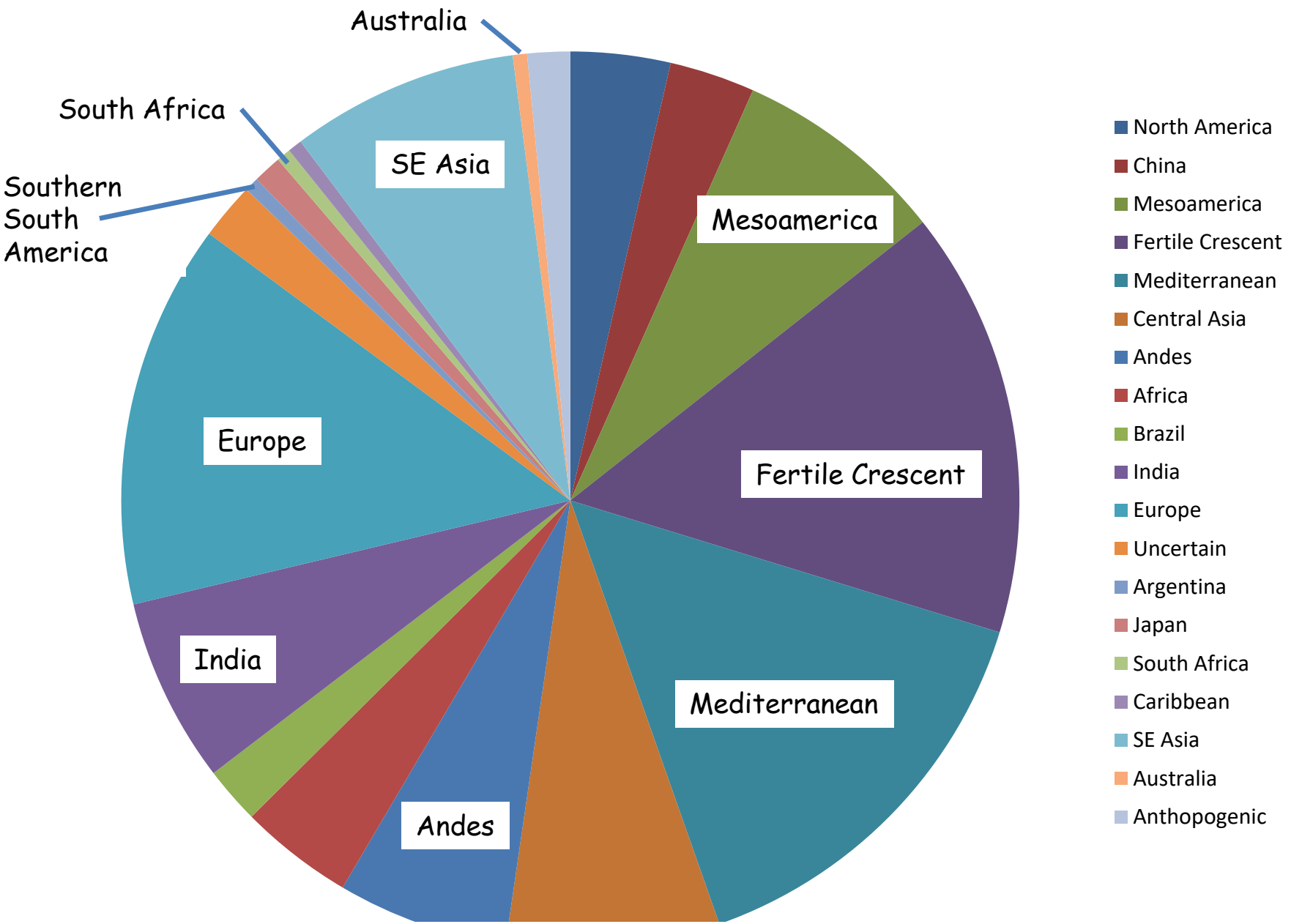
Seed

Aril

Flower Buds

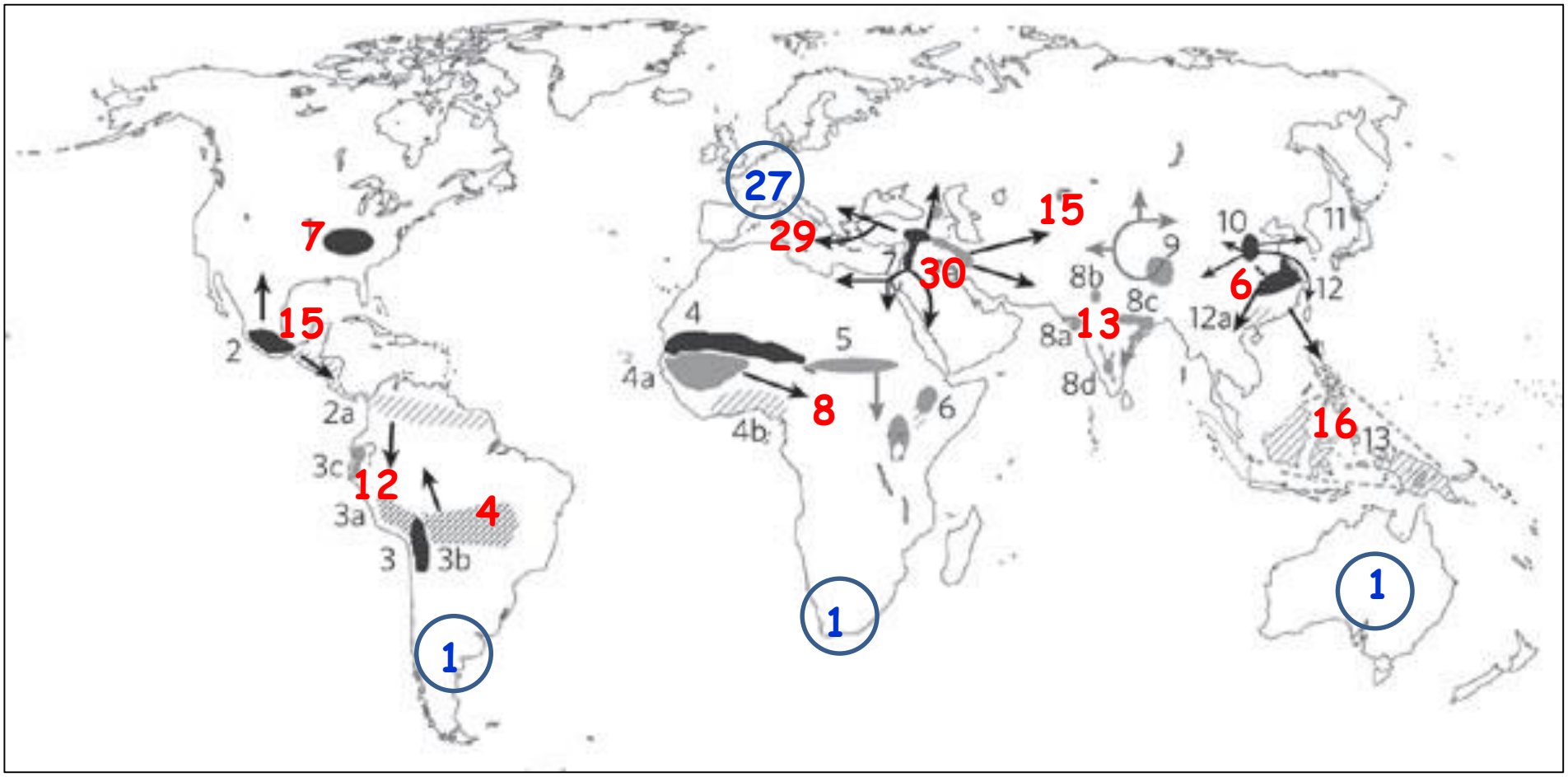
Cloves / *Syzygium aromaticum* / flower buds / Maluku Islands, Indonesia / Asia

Capers / *Capparis spinosum* / flower buds / Mediterranean / Mediterranean



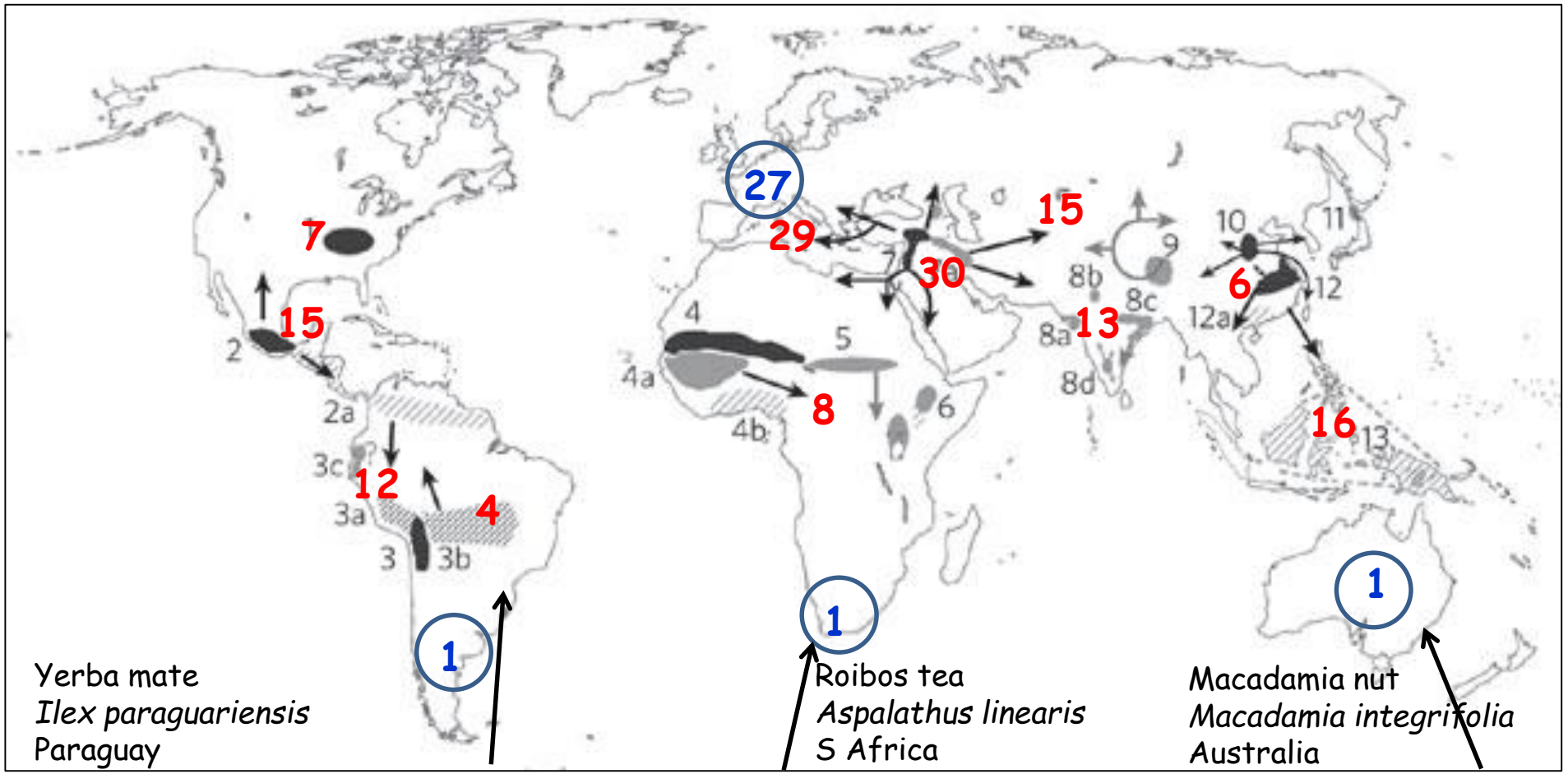
What are the geographic origins of the food that we eat?

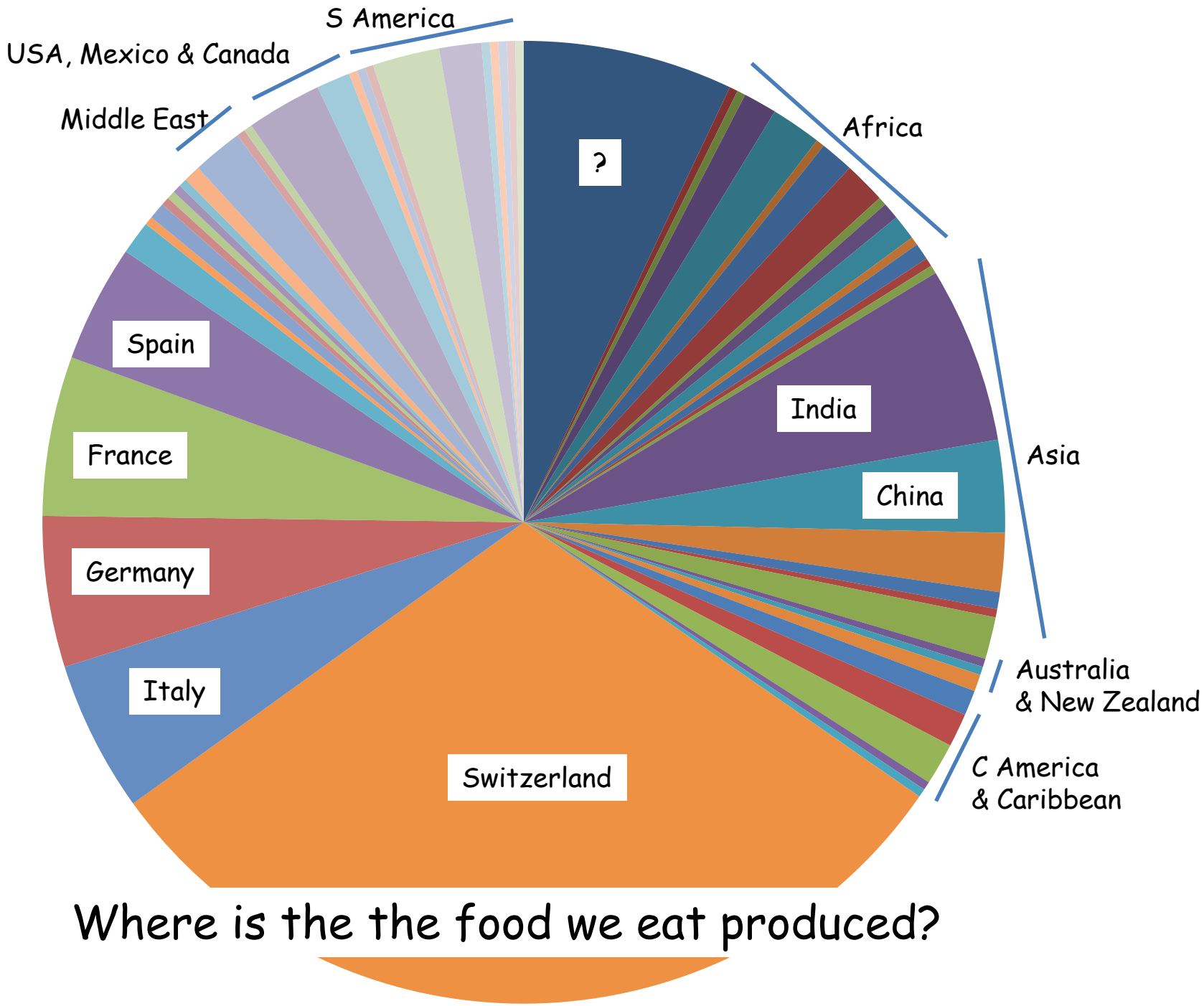
What are the geographic origins of the food that we eat?



- The majority of food plants eaten during the week do indeed originate in the centres of crop domestication
- The large cohort of European food plants are mainly local wild species

What are the geographic origins of the food that we eat?





Where is the the food we eat produced?

Where is the the food we eat produced?
57 countries – all continents

Globalisation

Approximately 50% of the food plants consumed by the class were produced in Europe, with >30% in Switzerland. This is a higher % than in some other European countries.

The food plants consumed by the class during one week were produced in 57 countries on all continents (except Antarctica).

Our diets are truly global in terms of crop origins and places of production.

Most crops are produced in areas outside their areas of origin.

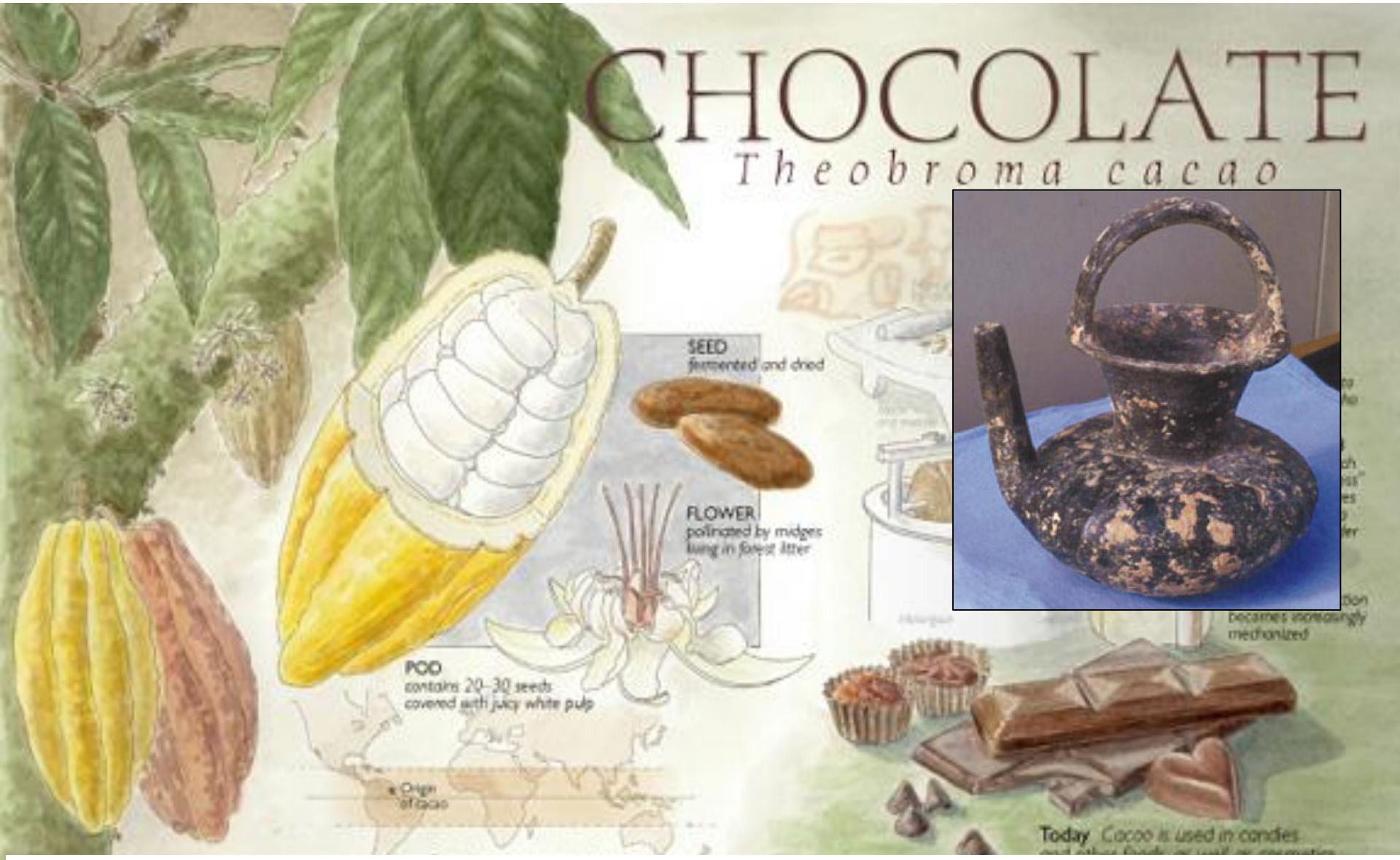
Everything is everywhere; only a little is as it was originally
A big long history – I just swallow in one little bite
What a big way plants have been travelling to reach my dish

Bio Cookies from COOP contain:

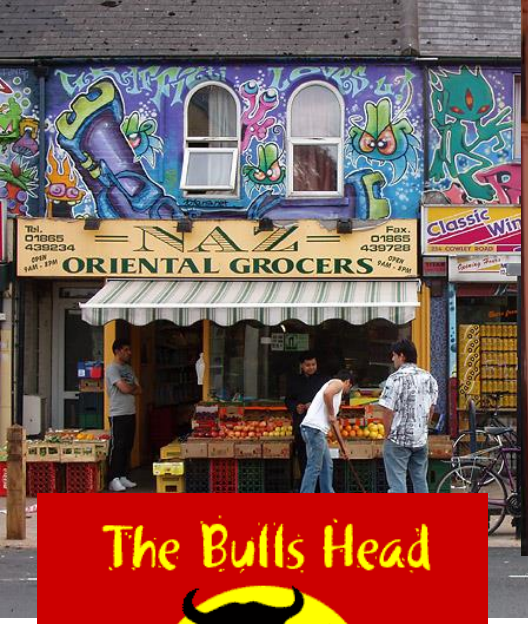
- Wheat from Switzerland, Europe, & N. America
- Soya from Brazil
- Sugarcane from Latin America
- Cacao from Ghana
- Oil Palm from Malaysia & Madagascar

Tobacco – *Nicotiana tabacca* – Solanaceae – Leaves – Andes - ????

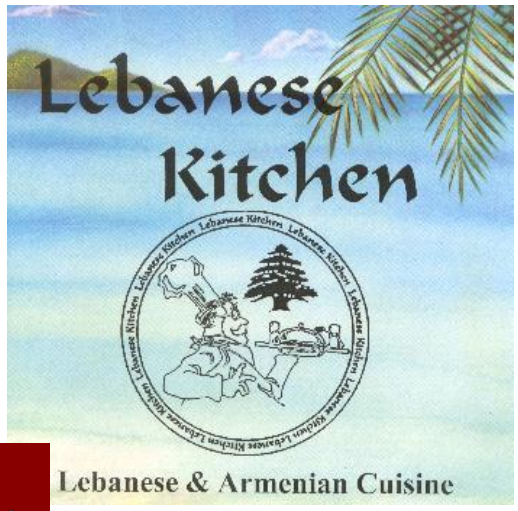
Imperial Tobacco Group plc: Well balanced mixture of Virginia, Burley and Orient tobacco – the origins are mixed – a blend including important contributions from Brazil, Canada & India



Cacao, *Theobroma cacao* is native in the lowland wet forests of the neotropics in Central & S America; used by the Mayan people 2600-1750BP; most of the cacao imported to Europe is grown in West Africa, e.g. Ghana; most of the chocolate eaten in Europe is manufactured in Europe



Globalisation of Food Food as a lifestyle



Food Kilometers

Range from 25,000 to 464,000 km, average 140,000 km

Complicated to calculate:

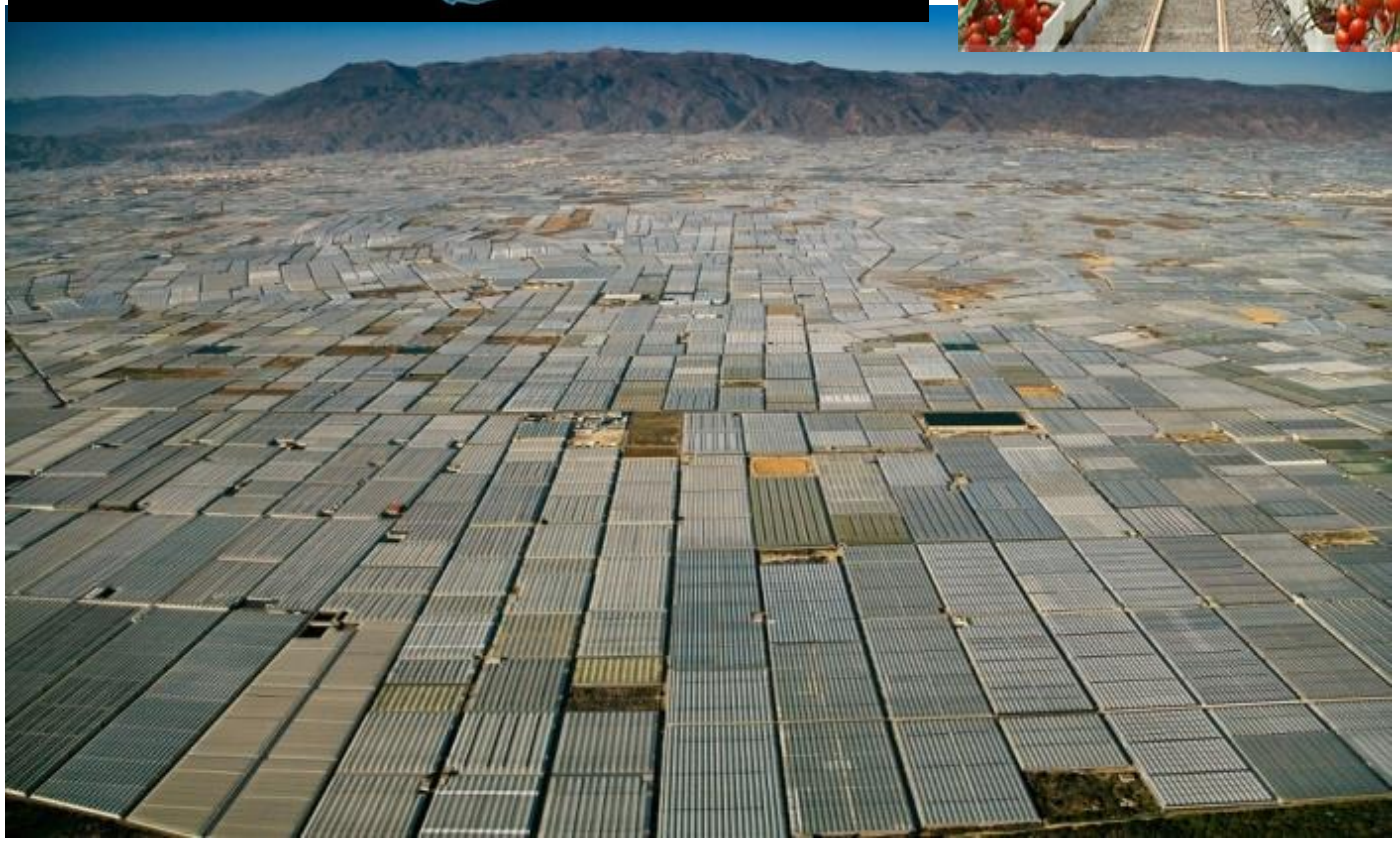
- Traceability of processed foods is opaque.
- Linear distances tend to underestimate real distances
- Shipping is done in bulk – a single portion accrues only a fraction of the km
- Need to take account of mode of transport – very different carbon emissions
- Many of the foods that come from far away are consumed in small quantities.

Food km have increased exponentially over the last 200 years from very low 1-20km (hunter-gatherers), to 100-200km 100-50 years ago (primarily agricultural societies, to >100,000km now (urban societies).

Food Km & seasonality

New Zealand

Kenya Zimbabwe Thailand Guatemala



Greenhouses + Seasonality

Mar del plastico
Almeria, Spain

Salads, tomatoes, & strawberries for Europe at Christmas

Locavores:

- Freshness/taste/nutritional content
- Organic or low-input growing methods
- Ecological sustainability
- Knowing where food comes from
- Support of local economies
- Personal connection with farmer
- Seasonality
- Support of small-scale business
- Community creation/sustenance
- Connection with place and with local ecology
- Stewardship of local environment
- Open space preservation
- Reducing carbon footprint
- Avoid contributing to tropical deforestation

One student plans to do a week of eating only food produced in Switzerland

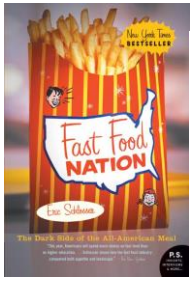
Bio vegetables face air freight ban…..
Food labelling and consumer choice
Organic food, local food, fair trade food
Information is a pre-requisite for changing consumer behaviour

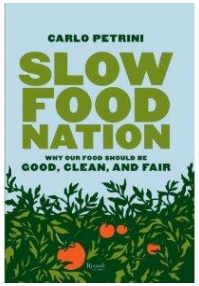
Bio Cookies from COOP contain:

- Wheat from Switzerland, Europe, & N. America
- Soya from Brazil
- Sugarcane from Latinamerica
- Cacoa from Ghana
- Oil Palm from Malaysia & Madagascar

Organic Food

Fast Food & Slow Food

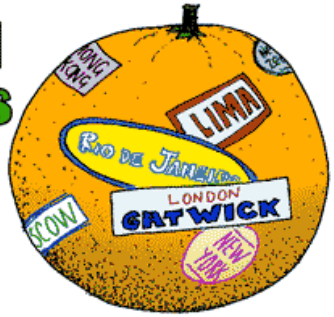




Fair Food

Globalisation, Food Miles & Seasonality

Food Miles
How well travelled is your dinner?



Locavores

BIO235 Course Assessment

Course Assignment = 50%

Exam = 50%

Exam will be on Tuesday 18th Dec 10:15-11:45 = 1.5 hrs

Mix of short answer questions and short essay questions covering the whole course

All of them will be easy & straightforward!

BIO 235 Plants and People - Evolution and Domestication of Crops

Student Course Evaluation (LVB)

- Link to survey: https://qmsl.uzh.ch/en/AMNWA

- Survey period: Nov 19 – Dec 9, 2018 (Reminder: Dec 3)

- Number of participants, who receive the access data automatically: 26 participants