The Solanaceae: Novel Crop Potential for the UK

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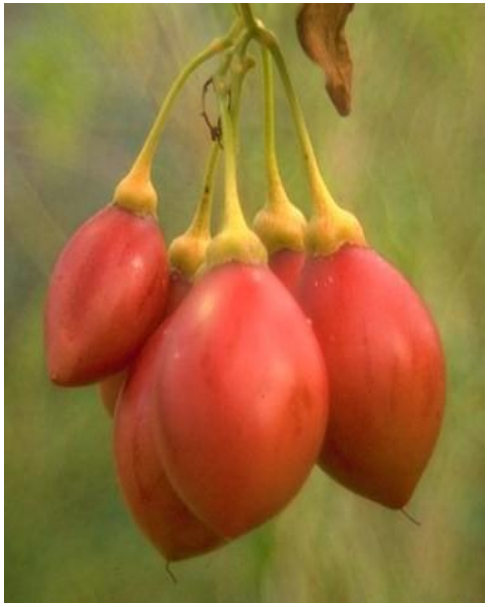

1. Tomate de arbol, *Solanum betaceum* (red-skinned cultivar)

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Introduction to the family Solanaceae

- The Solanaceae, or nightshade family, is a highly successful group of flowering plants originating in South America and now represented on very vegetated continent. There are somewhere between 3-4000 species.
- Nightshades were some of the first plants to be exploited by humans .
- Peppers were first cultivated around 5000AD, making them amongst the first crops to be cultivated in the New World.
- The effect of the nightshades on the world and their popularity as a source of food has become enormous.
- In 2007 alone, 33 million hectares of nightshade crops were cultivated worldwide, producing almost 515 million tonnes.

Nightshades provide us with a **wide variety of resources:**

- **food and crop plants**, eg potato, tomato, capsicums
- **ornamentals**, eg *Petunia*, ornamental tobacco, angel's trumpet ,
- **medically useful substances,** eg alkaloids, capsaicinoids and steroids
- **phytochemicals** with insecticidal properties, eg *Withania*, *Nicotiana*
- **ethnobotanical uses,** eg plants used for tanning leather, medicines, etc, eg bitter tomato and *Cestrum* spp
- **recreational use**, eg tobacco, snuff
- **psychoactive substances** used in tribal rituals, eg *Datura, Latua*

They are also a source of **deadly poisons**, such as belladonna and mandrake, and can become **successful weeds**, eg black nightshade, American nightshade.

Solanaceae-wider resources

2. **Food and crop plants**: *Solanum tuberosum*, the potato-one of the major food crops that feed the world

3. **Ornamentals:** *Petunia*-popular ornamental worldwide

4. **Source of alkaloids:** *Hyoscyamus niger*, black henbane-a source of hyoscine

5. **Source of capsaicinoids:** *Capsicum* species provide capsaicin substances-used in the treatment of arthritis, etc

6. **Phytochemicals:** *Withania* sp-a source of insecticidal withanolide substances

Solanaceae-wider resources

7. **Psychoactive substances:**
Latua pubiflora, "*palo muerto"*-
used in shamanic rituals in Chile

8. **Recreational uses:**
Nicotiana tabacum-the source of tobacco,
one of the most addictive substances
ever known

9. **Ethnobotanical uses:**
Solanum incanum, bitter tomato: fruit pulp used
for tanning leather

10. **Deadly poisons:**
Atropa belladonna, deadly nightshade
-all parts of which contain toxic alkaloids

11. **Successful weeds:**
Solanum nigrum, the black nightshade
-successful worldwide weed

Food Resources

- Over 30 species of nightshades are commonly cultivated for food across the world.

- These comprise species of *Solanum, Capsicum, Physalis* and *Lycium.*

- Of these, only 4 are cultivated on a commercial scale in the UK:
  -*Solanum tuberosum*, potato
  -*Solanum lycopersicum*, tomato
  -*Solanum melongena*, brinjal eggplant
  -*Capsicum annuum*, sweet peppers and hot peppers

- In 2007, a total area of 139,400 ha of nightshade crops was grown in the UK; this amounts to only 0.6% of total land area! (compared with 1,820,000 ha of wheat, over 7% of total land area).

- There have been no significant novel nightshade introductions for commercial cultivation in the UK for about 300 years!

- Europeans have always had a wary attitude towards nightshades. The eggplant was originally known as the “mad apple,” because it was believed that eating it would cause insanity!

Solanaceae food crop species commonly cultivated in the UK

12. *Solanum tuberosum,* potato (139,000 ha in cultivation in UK in 2007)

13. *Solanum lycopersicum*, tomato (200 ha in cultivation in UK in 2007)

14. *Capsicum annuum*, sweet pepper, hot pepper (100 ha in cultivation in UK in 2007)

15. *Solanum melongena*, brinjal eggplant (approx 100 ha in cultivation in UK in 2007)

Edible Solanaceae Species-Worldwide

Solanum

- **Total number of known species of *Solanum* = approx 1500 Worldwide**
- **It is the most valuable genus of food nightshades to the human race**
- **Total number of species with food potential = over 200**
- ***Future Potential for Solanum novel crop plants is therefore considerable***

-25 species of staple crops, worldwide, including: European potato (*S tuberosum*), Andean potatoes (*S phureja*, etc), tomato (*S lycopersicum*), aubergine (*S melongena*), etc.

-approx 50? species of semi-cultivated food plants, found close to human settlements, including: coconilla (*S stramonifolium*), lulita (*S hirsutissimum*), torvum eggplant (*S torvum),* etc.

-approx 50? species of edible wild relatives of domesticated crops, including: wild brinjal eggplant allies (*S cumingii*, etc), wild scarlet eggplant (*S anguivi*), wild tomatoes (*S pimpinellifolium*, etc), etc.

-approx 100? species collected from the wild in the wider vicinity of human settlements, including: bay fruit (*S barbeyanum),* jurubeba *(S paniculatum),* kangaroo apple (*S aviculare*), etc.

Edible *Solanum* Species Across the World

16. *S sisimbriifolium*, litchi tomato, a weedy species found across Central America and Mexico; may be semi-cultivated

17. *S barbeyanum*, *fruto bayo*, found in the Amazon rainforest ; fruit collected from the wild

18. *S aethiopicum*, the scarlet eggplant -cultivated across west and central Africa and Brazil; fruits and leaves may be eaten

19. *S macrocarpon*, the gboma eggplant, cultivated across much of tropical Africa for its fruits

20. *S sessiliflorum*, the cocona, cultivated on the eastern side of the Andes for its fruits

21. *S stramonifolium*, the coconilla, grows as a ruderal, around villages in tropical South America

Edible Solanaceae Species-Worldwide

Capsicum

- **Total number of known species = around 30, Latin America**
- **Most species are believed to have food potential**

-5 species of staple crops, cultivated in many parts of the world including: *C annuum* var *annuum*, sweet pepper, hot pepper; *C frutescens*, tabasco forms; *C chinense*, habanero, jolokia; *C baccatum* var *pendulum*, aji peppers; *C pubescens*, rocoto.

-1 semi-cultivated variety: *C annuum* var *aviculare*, chiltepin, chilpiquin.

-approx 20 wild species are collected for food: *C baccatum* var *baccatum*, wild aji peppers; *C cardenasii*, ulupica; *C eximium; C chacoense*, quitucho, etc.

Food *Capsicum* Species Across the World

25. *C annuum* var *annuum*, hot pepper, cultivated in most parts of the world

26. *C chinense*, cultivated for its highly pungent pods

27. *C frutescens*, cultivated for its erect, pungent fruits

28. *C pubescens*, cultivated for its fiercely hot and fleshy fruits

29. *C baccatum* var *pendulum*, the favourite cultivated pepper of the Andes

Edible Solanaceae Species-Worldwide

Physalis

- **Total number of known species of *Physalis* = approx 75, New World and China**
- **Total number of species with food potential = 8 or more**

-3 cultivated species: *P peruviana*, uchuva, cultivated across Andean SouthAmerica; *P philadelphica*, tomatillo, cultivated in Mexico, Guatemala and parts of S America; *P alkekengi*, Chinese lantern plant, cultivated in parts of Cuba.

-4 semi-cultivated species which appear as tolerated adventives on farmland; may be harvested, eg *P pubescens*.

-1 species, *P angulata*, collected from the wild in parts of lowland S America

35. *Physalis peruviana*, uchuva or Cape gooseberry

36. *P philadelphica*, tomatillo

37. *P pubescens*, hairy tomatillo, semi-cultivated in S America

Edible Solanaceae Species-Worldwide

Lycium

- **2 cultivated species, *L barbarum* and *L chinense*, China**
- **Total number of known species=around 80, worldwide**

38. *Lycium chinense*, goji or Chinese wolfberry

Edible Solanaceae Species-Worldwide

Lycianthes

- **Total no of known spp = 200, worldwide**
- **No cultivated food species**
- **1 edible species collected from wild, *L asarifolia***
- **Most species produce very small fruits.**

39. *Lycianthes asarifolia* fruit, approx 1.5cm wide

Edible Solanaceae Species-Worldwide

Jaltomata

- **Total no of spp known = around 20, Mexico, C and S America**
- **5 species collected from the wild or tolerated as weeds**

40. *Jaltomata procumbens*, the jaltomate

Exotic or unusual sol crops with known consumption in the UK

Crops with substantial history of use in UK:

-**Cape gooseberry**: has been used as an exotic fruit in UK for some time, mostly amateur-grown; more recently imported in quantity from S America and available in supermarkets, etc.

-**Goji** : has been cultivated in UK as an ornamental plant for many years, but has recently been endowed with "superfruit" status. In 2007, FSA examined the goji case and determined that there was a significant level of consumption prior to 15 May 1997 in Europe. It did not therefore have to go through the "Novel Foods" procedure. *Lycium barbarum* & *L chinense*.

-**Tomatillo**: has been used as an exotic vegetable in UK for several years, mostly amateur-grown.

Solanaceae species with high novel food crop potential for the UK

- *S aethiopicum*, scarlet eggplant
- *S betaceum*, tomate de arbol, or tree tomato
- *S macrocarpon*, gboma eggplant
- *S muricatum*, pepino dulce
- *S quitoense*, lulo, naranjilla
- *S scabrum* (syn *S melanocerasum*), huckleberry

- *C baccatum* var *pendulum*, aji peppers
- *Capsicum pubescens*, rocoto

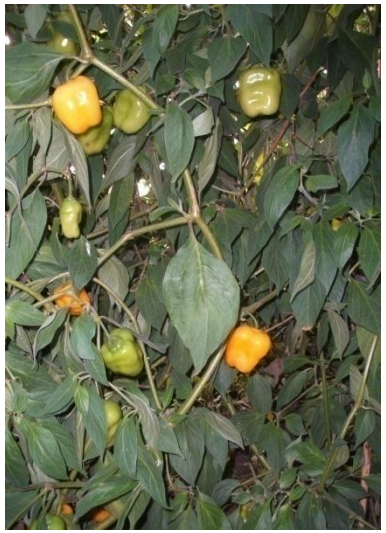
- *Physalis peruviana*, uchuva, or Cape gooseberry
- *P philadelphica*, tomate de cascara, or tomatillo

- *Lycium chinense*, *L barbarum*, goji berry

Capsicum pubescens, rocoto (locoto, chile manzano, chile caballo, canario, etc)

41. Bush in 2nd year of growth

42. Cultivation in polytunnels, Cornwall



43. "Canario" form

44. Growth habit sometimes becomes scrambling

45. Luxuriant growth with characteristic purple flowers

Solanum muricatum, pepino dulce (cachum, melon pear, sweet pepino, etc)

48. Pepino grows well in hedge form

49. Typical pale violet flowers with purple stripes

50. Variety originating from Ecuador

51. Purple stripes often develop as the fruit matures

52. Variety from Columbia

Solanum quitoense, lulo (Quito orange, naranjilla)

55. Prolific growth starts in late spring (UK)

56. Semi-cultivation in S America

57. Spiny form

58. Typical flowering branches

59. Fruits have a covering of small hairs

Useful Features of the Novel Nightshade Crops

- Many are perennials, therefore suit “protected permaculture” approach
- Yields can be comparable to those obtained in countries of origin
- Most are commercially rare in the UK
- Nightshades are potentially high value niche crops, eg pepinos @£4.99 each!
- Many species have unusual fruits with exotic flavours
- Fruits are very high in vitamins and minerals-“superfruits!”

Future considerations

- Set up UK novel crops working group; develop links/co-ordinate research
- Set up international Solanaceae novel crops working group; develop links/coordinate research with other groups across world (eg S America, Valencia (Spain), Netherlands, Israel, etc)
- Feasibility studies/trials to evaluate potential novel crops (eg Eden Project, Cornwall, UK; Hadlow Horticultural College, Kent, UK)

References/Further Reading

- D'Arcy WG (ed) 1986. ***Solanaceae: Biology and Systematics***. New York: Columbia University Press.
- *Eucarpia* (|European Association for Research on Plant Breeding) working group on Genetics and Breeding of *Capsicum* and Eggplant: www.comav.upv.es/capsicumeggplant/
- Hawkes JG, Lester RN, Nee M, Estrada N (eds) 1991. ***Solanaceae III: Taxonomy, Chemistry, Evolution.*** Kew: Royal Botanic Gardens.
- Hawkes JG, Lester RN, Skelding AD (eds) 1979. ***The Biology and Taxonomy of the Solanaceae.*** London: Academic Press.
- Heiser, CB Jr 1987. ***The Fascinating World of the Nightshades***. New York: Dover Publications Inc.
- Nee M, Symon DE, Lester RN, Jessop JP (eds) 1999. ***Solanaceae IV: Advances in Biology and Utilization.*** Kew: Royal Botanic Gardens.
- Samuels BJ. 2009. *Capsicum pubescens*: an underutilised species of hot pepper. *Sol Newsletter* 25: 5-8.
- Samuels BJ. 2009. The Solanaceae-novel crops with high potential. *Organic Grower* 9: 32-34.
- *Solanaceae Source* Project: www.nhm.ac.uk/solanaceaesource . This is a UK/USA project with the aim of naming and describing all known species of *Solanum* and publishing them on the internet. Part of the "Planetary Biodiversity Initiative." Project should be completed 2010.
- Spooner DM, Bohs L, Giovannoni J, Olmstead RG, Shibata D (eds) 2007. ***VI International Solanaceae Conference: Genomics Meets Biodiversity*.** Belgium: ISHS.
- Van den Berg RG, Barendse GWM, van der Weerden GM, Mariani C (eds) 2001. ***Solanaceae V: Advances in Taxonomy and Utilization.*** Botanical Garden of Nijmegen: Nijmegen University Press.
- www.hvanbalken.com . Belgian online resource for researchers of the family Solanaceae.

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