Linking Taste to the Market Place

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Bio-Valley, Basel 15th October 2009

- Who are we and what do we do?
- Why tomato?
- What is flavor?
- Linking the chemistry of flavor to the sensation
- Linking flavor profiles to people (consumers)
- Product development…

Who we are and what we do

We bring plant potential to life

- Syngenta is a world-leading agribusiness committed to sustainable agriculture through innovative research and technology
- With products in Crop Protection and Seeds, Syngenta helps growers around the world increase crop yields to meet the world's growing demand for food, feed and fuel
- Syngenta helps protect the environment, improve health and the quality of life

Syngenta at a glance








- A uniquely broad product portfolio
  - A leader in crop protection
  - Third in high-value commercial seeds
- World-class science
  - $1billion invested in R&D in 2008
  - > 300 patents for new inventions in 2007
- Global reach and experience
  - Over 24,000 employees in more than 90 countries
- Commitment to working with customers
  - Tailoring solutions to individual needs

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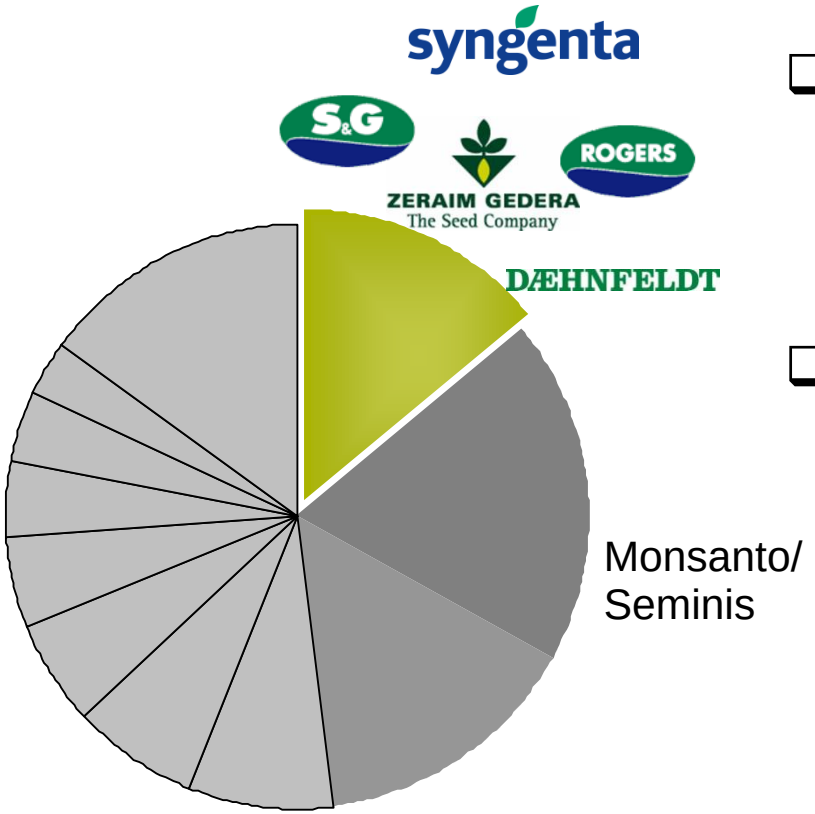
Vegetables: growing market, strong position

2007 seeds market value*
$3.5bn



- ❑ Market growth: 2-3% p.a.
  - fragmented but consolidating
  - race for technology breakthrough
- ❑ Syngenta outperforming
  - double-digit growth
  - high profitability
  - innovative business models

* Syngenta includes Daehnfeld, Zeraim pro forma

Vegetable Seeds

- **Solanacea**
  - Tomato
  - Pepper
  - Eggplant

- **Leafy**
  - Broccoli
  - Brussels Sprout
  - Cauliflower
  - Cabbage
  - Salads
  - Spinach

- **Other crops**
  - Radish
  - Carrots
  - Leek
  - Onion
  - Red Beet
  - Okra
  - Gourds
  - -…

- **Cucurbits**
  - Watermelon
  - Melon
  - Squash
  - Cucumber

- **Large seeds (LSV)**
  - Sweet corn
  - Peas
  - Beans

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What is flavor?

What is Flavor?

Taste is considered easier to approach than fragrance

Fragrance is via stimulation of nasal receptors

- ~350 functional receptors, its very complex!
- Humans can detect thousands of different “smells”

Taste is via stimulation of tongue receptors (mainly)

- A few dozen receptors
- Much simpler than fragrance
- Mostly “Bitter” – to avoid poisons?

The Sense of Taste

Five basic tastes

- **SALT - sodium chloride**

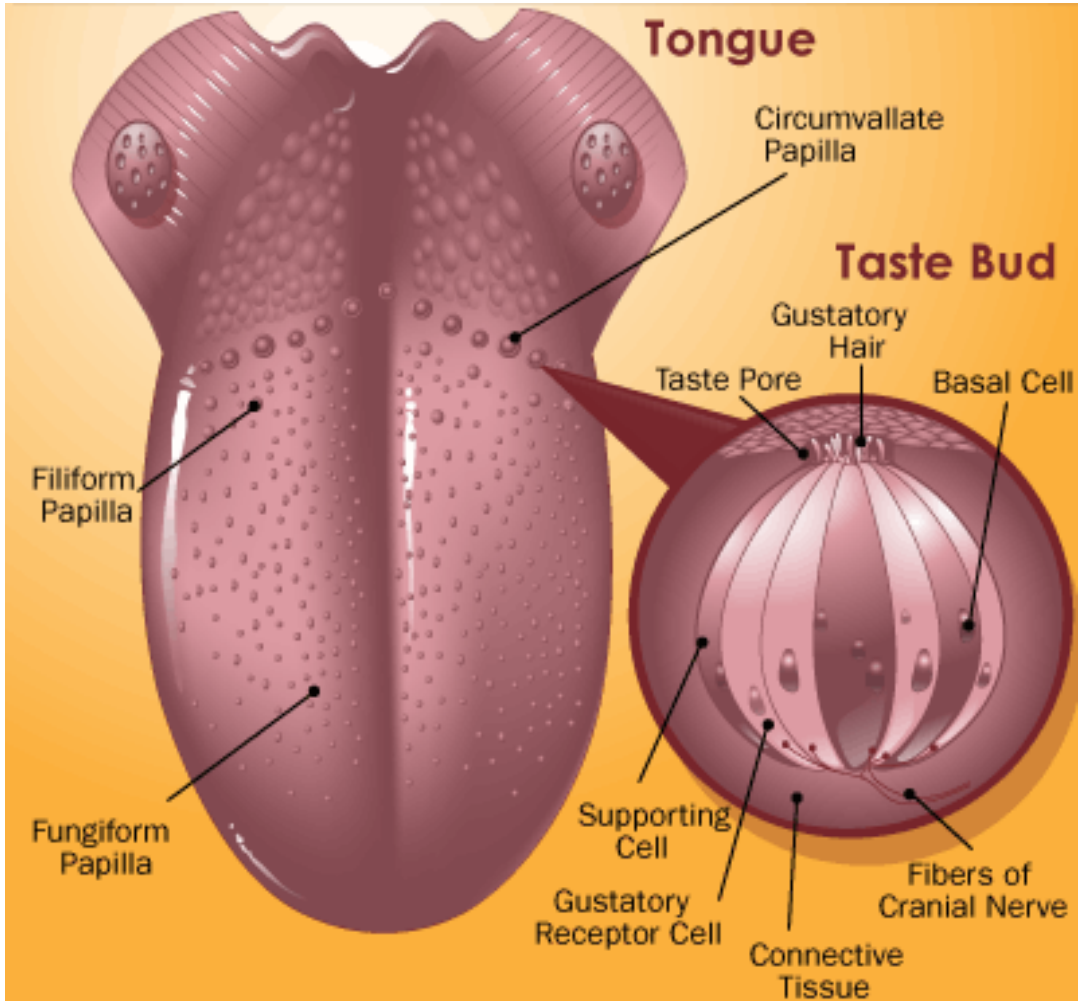
- **SWEET - sucrose, saccharine**

- **SOUR - acetic acid, tartaric acid**

- **BITTER - caffeine, quinine**

- **UMAMI - monosodium glutamate**

Taste Perception

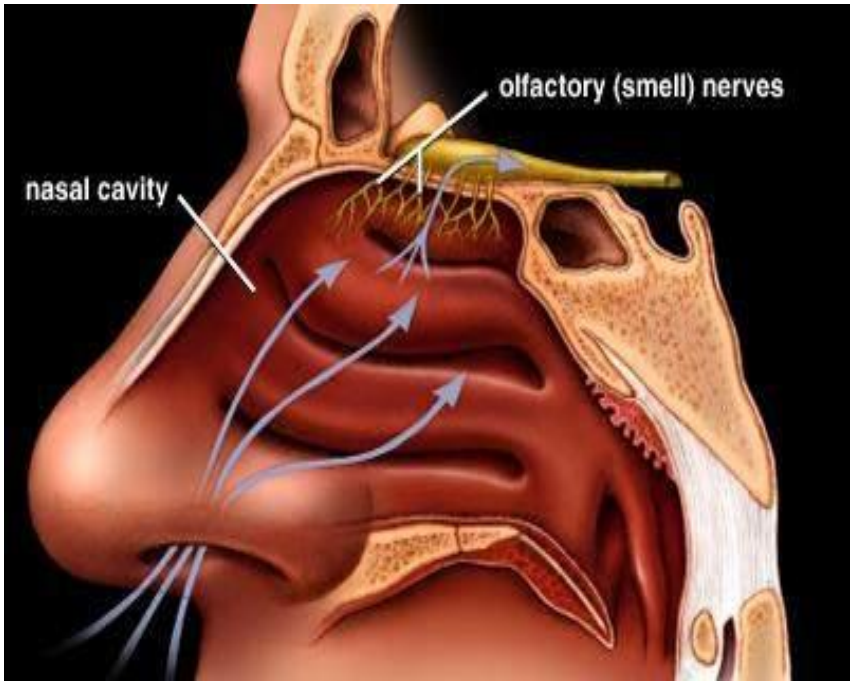


Compounds stimulating the sense of taste are all water soluble

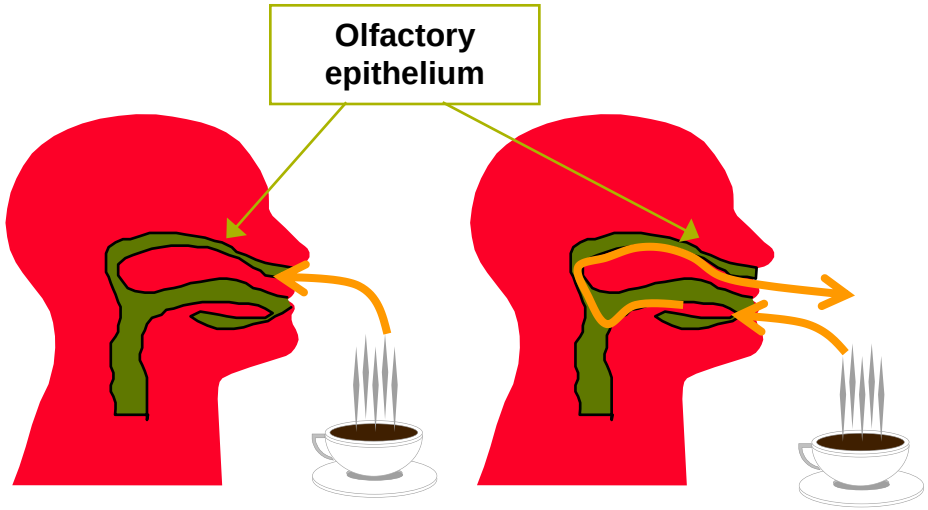
The compounds act on receptors in mouth or on tongue

The Olfactory Organ

Compounds contributing to aroma are volatile and they stimulate the olfactory organ



Aromas are perceived in two ways:



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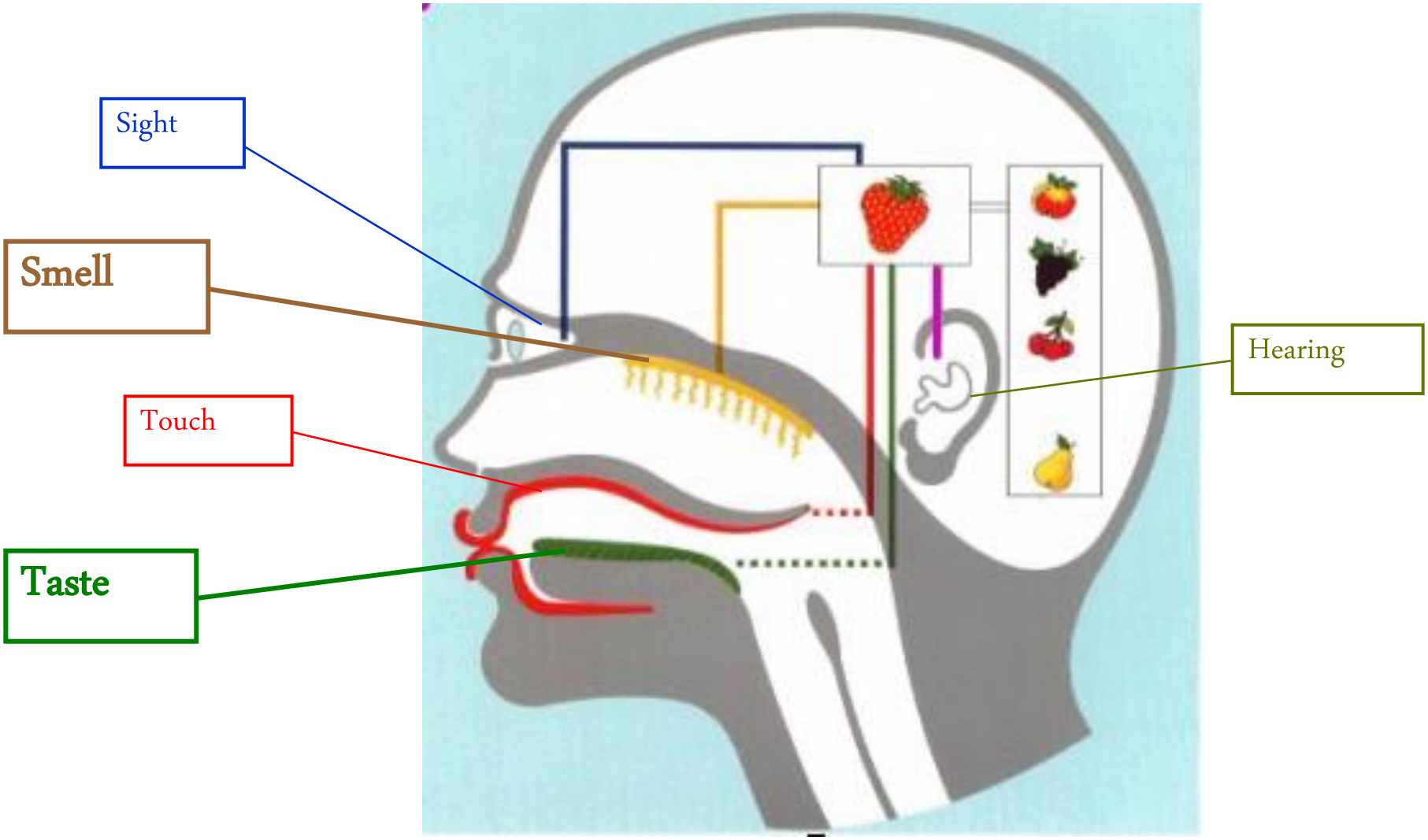
Flavour Perception is more than just Taste and Smell



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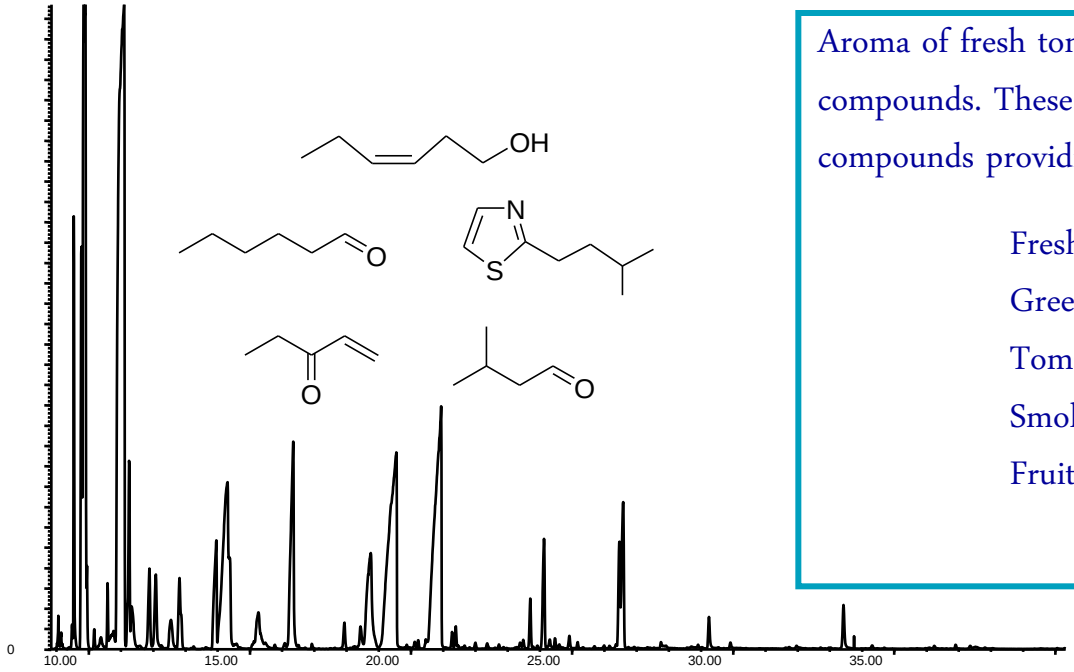
Perception of Tomato Flavour



Aroma of fresh tomatoes due a mixture of volatile chemical compounds. These have been well characterised and include compounds providing attributes such as:

- Fresh tomato
- Green
- Tomato vine
- Smoky
- Fruity

Taste of fresh tomatoes is due water soluble compounds which may provide:

- Sweet
- Sour
- Salty
- Savoury

TOMATO FLAVOUR

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Linking the chemistry of flavor to sensation

Recent study on the flavour of different tomato varieties

- Sensory evaluation carried out using a panel of 12 trained assessors
- Panel described taste and aroma attributes of tomatoes and scored on a line scale

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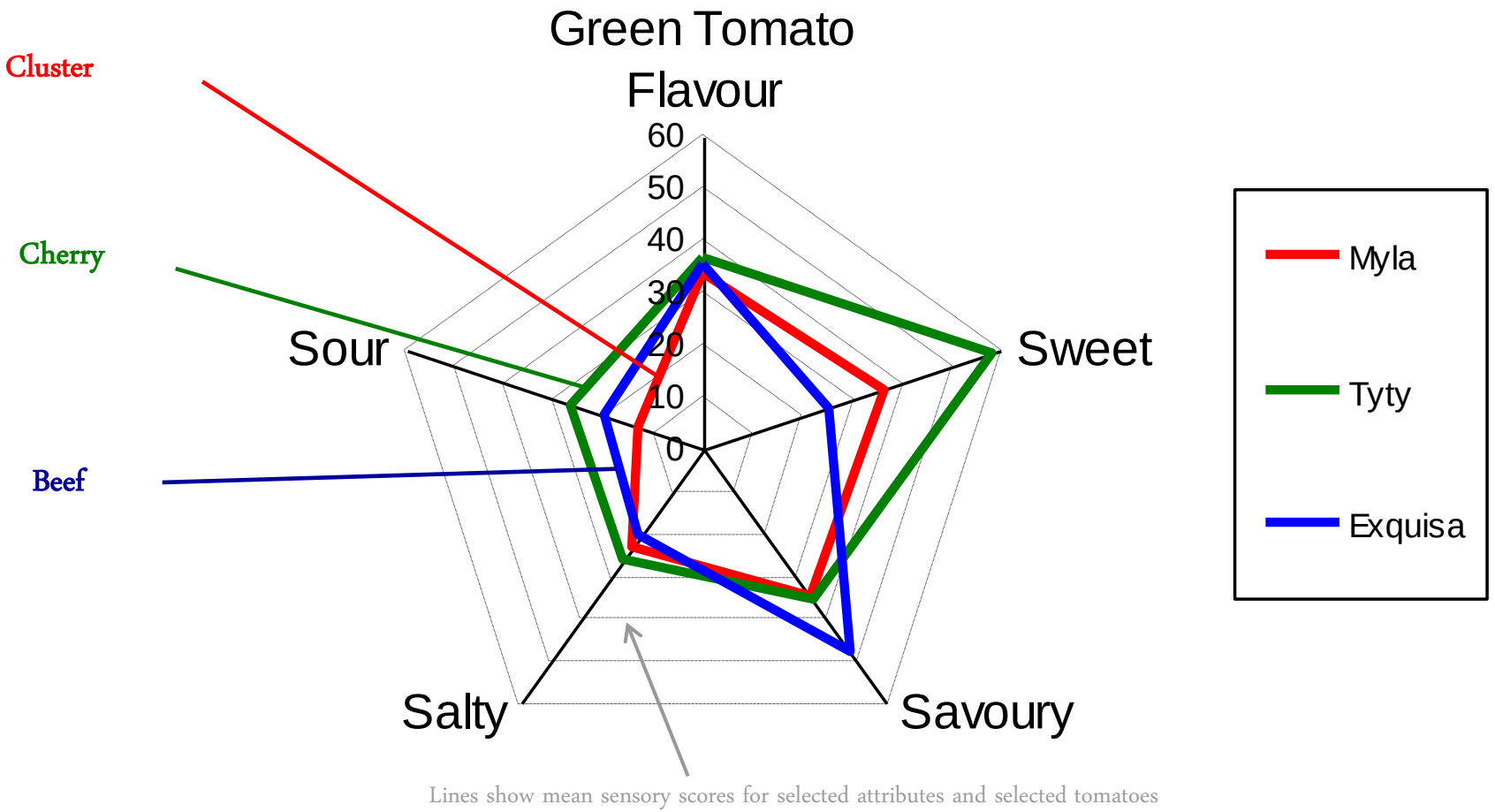
Some sensory attributes used by a Panel for Tomatoes

Taste	*Odour*	*Aftertaste*
Savoury	Green Tomato	Sour Aftertaste
Sweet	Green	Sweet Aftertaste
Salty	Smoky	
Sour	Citrus	
	Berry fruit	
	Earthy	

Comparing types of tomato

Sensory scores for different attributes



Lines show mean sensory scores for selected attributes and selected tomatoes

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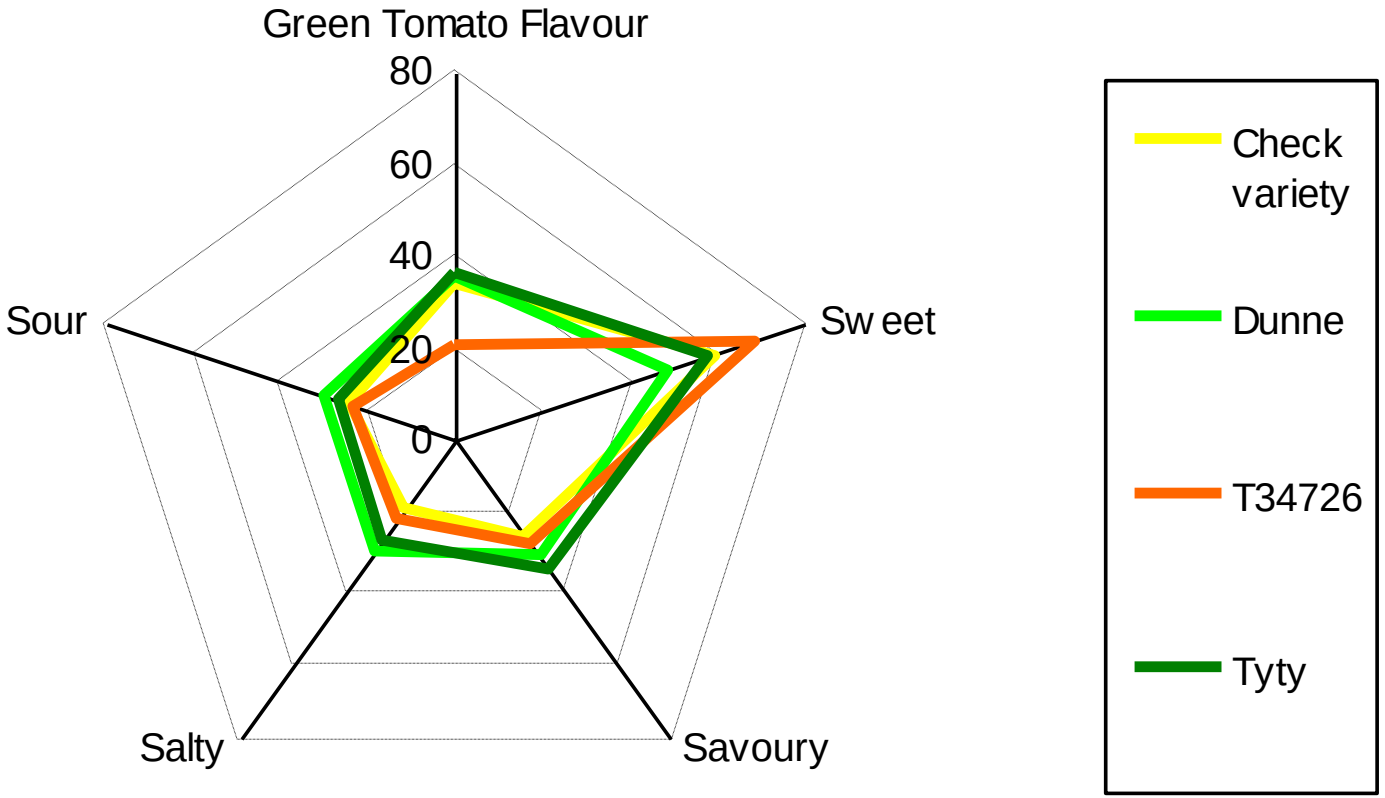
Compare Cherry tomatoes

Sensory scores for different attributes



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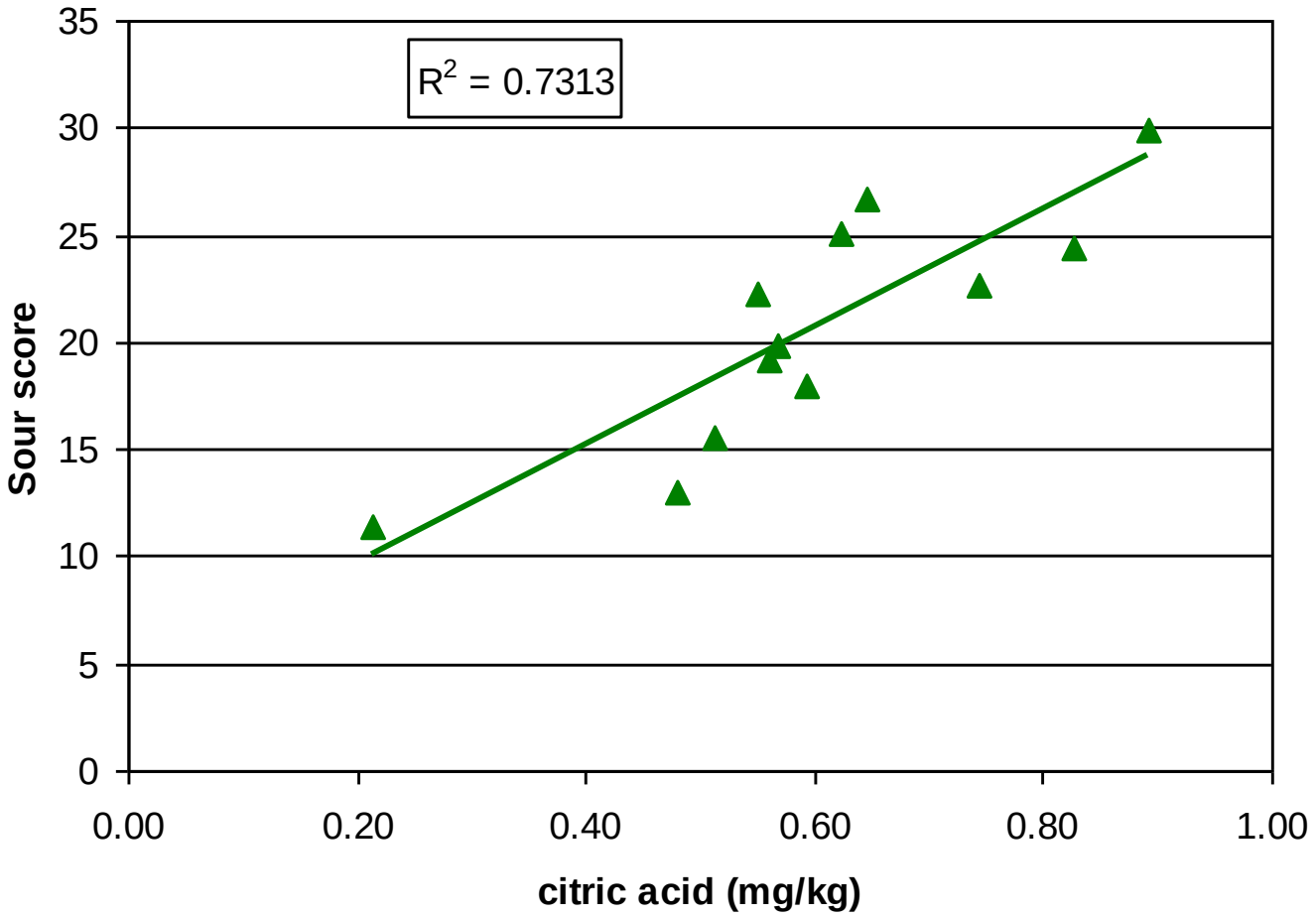
How do sensory attributes relate to chemical analysis of taste and aroma compounds?

- Analysed for:

- Volatile compounds	*aroma*
- Free amino acids	*savoury, sour, sweet*
- Ribonucleotides	*savoury (umami)*
- Citric Acid	*sour*
- Sugars	*sweet*

Correlation between panel Sour Score and chemical analysis of Citric acid



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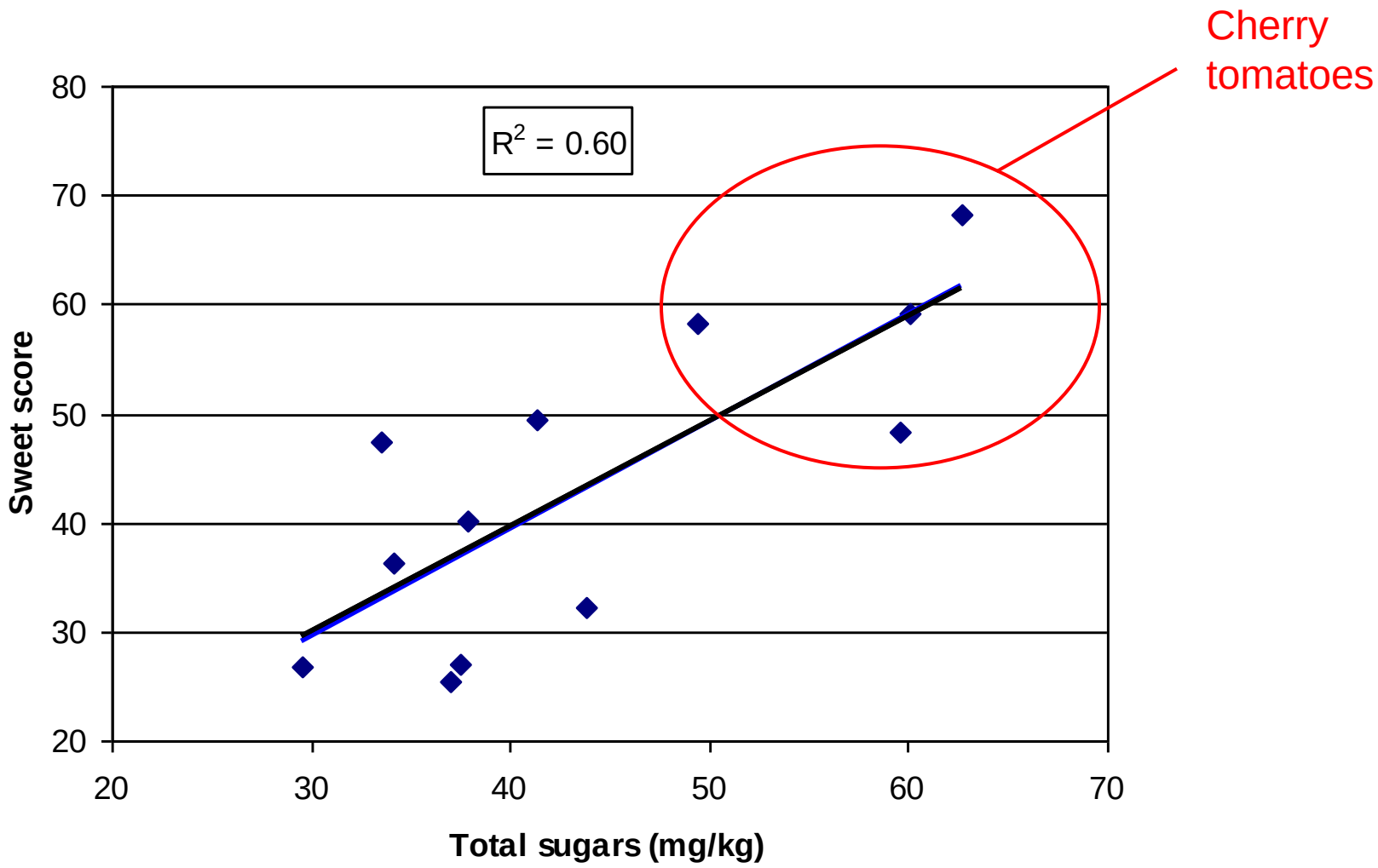
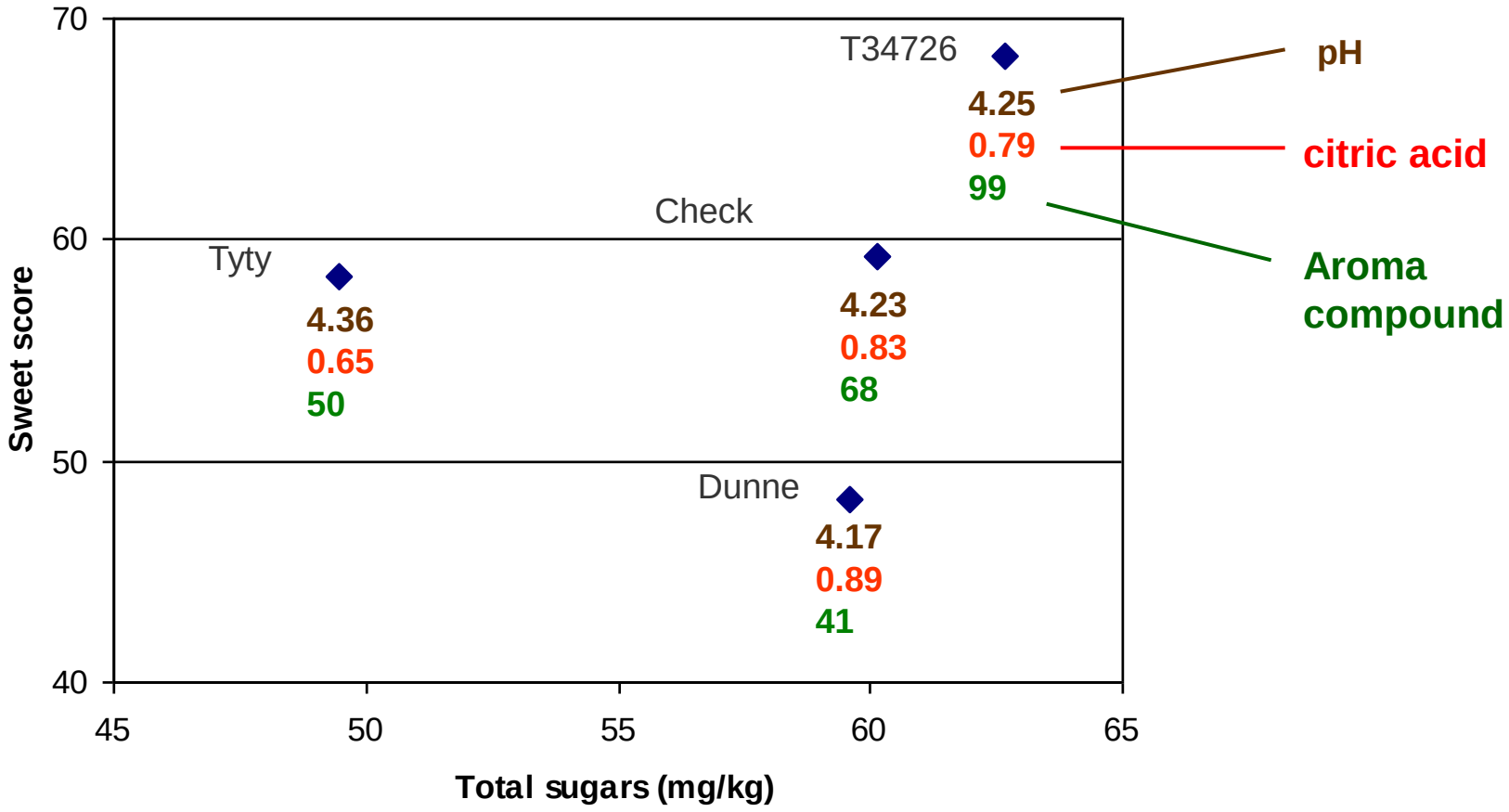
Correlation between panel Sweet Score and Chemical analysis of Sugars



Correlation of Sweet Score and Sugars for Cherry Tomatoes



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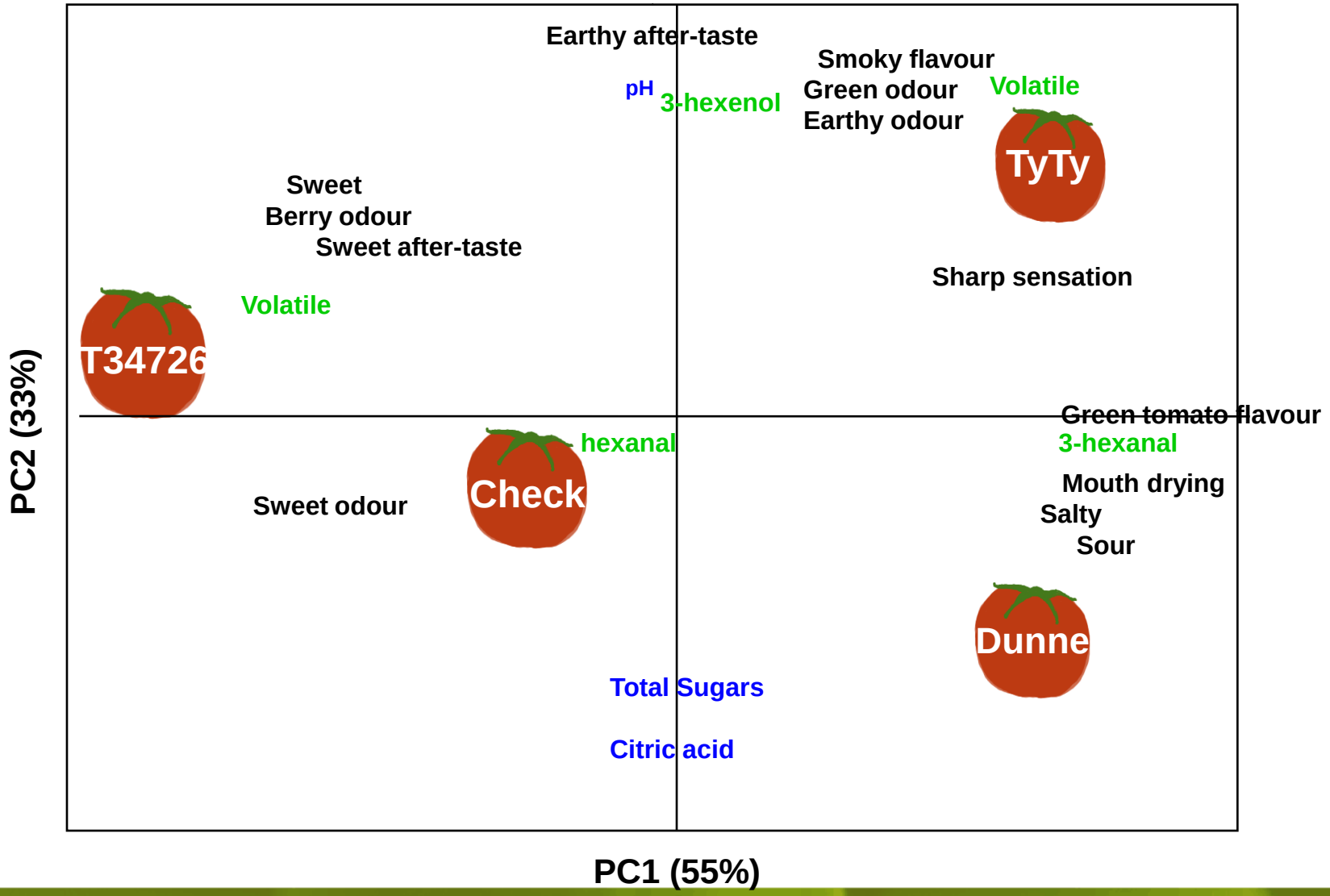
Combing Flavor Chemistry and Sensory Analysis



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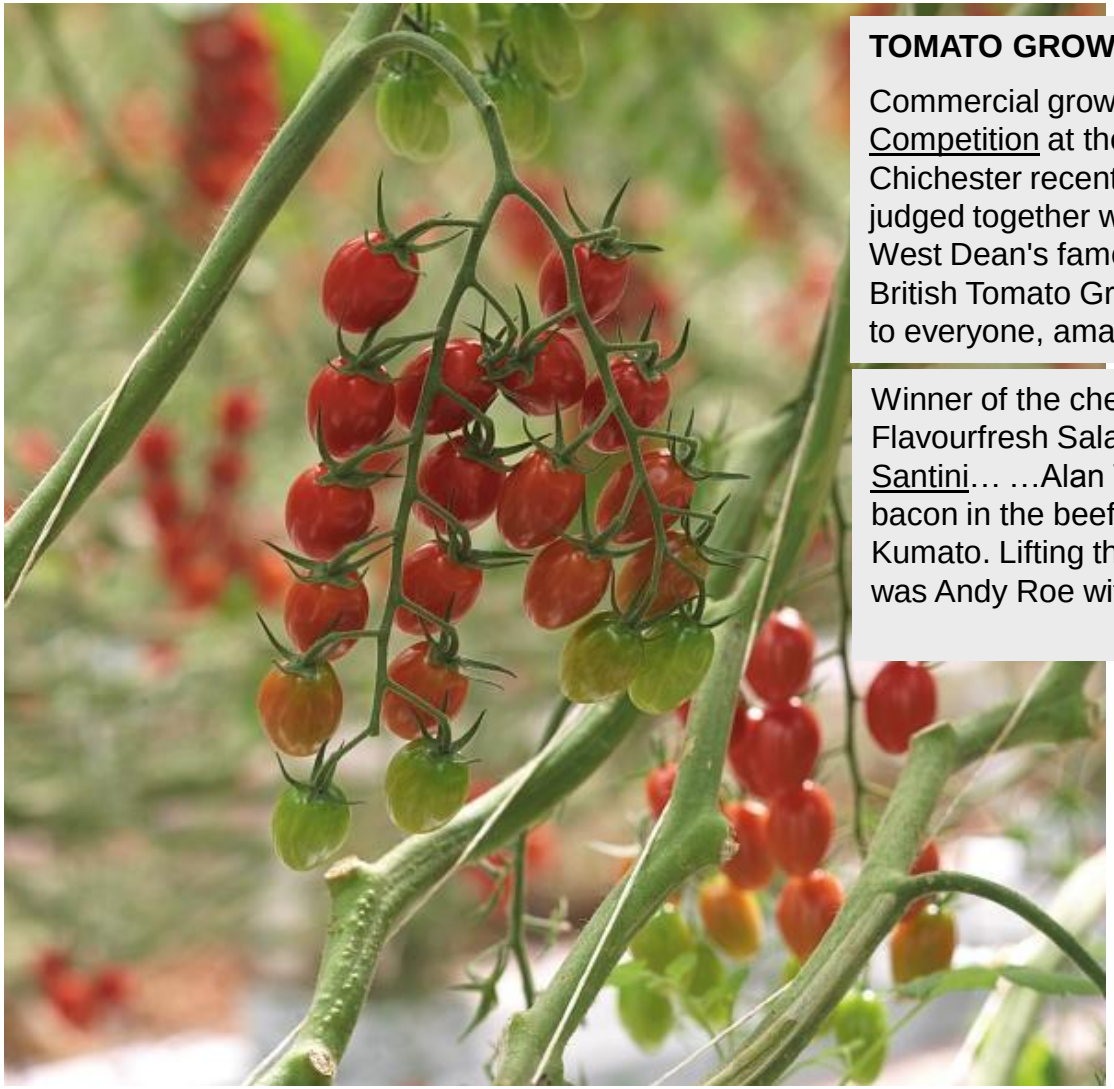
Summary of results from study

- Some taste parameters correlate well with chemical analysis, e.g. sour and citric acid
- Perception of sweetness is affected by other components as well as sugar
- Sugar alone is not a good measure of perceived sweetness
- Flavour profile of tomatoes is complex
- However, there are significant opportunities to utilise varietal differences to provide range of flavour characteristics to consumers
- As new varieties become available, tomatoes can be developed to provide choice of flavour and other eating quality characteristics

Angelle/Santini



TOMATO GROWERS TASTE SUCCESS - 22/09/2009

Commercial growers triumphed in the Tastiest Tomato Competition at the wonderful West Dean Gardens near Chichester recently, taking the top places in all the categories judged together with the prize for the overall winner. Held during West Dean's famous Totally Tomato Show and organised by the British Tomato Growers' Association, the competition was open to everyone, amateur and professional, young and old.

Winner of the cherry and baby plum category was Andy Roe of Flavourfresh Salads in Lancashire with an entry of baby plum Santini… …Alan Taylor of Flavourfresh Salads brought home the bacon in the beefsteak competition with the exotic looking Kumato. Lifting the Len Summerton Cup as the overall winner was Andy Roe with Santini.

http://www.britishtomatoes.co.uk/pressroom/view.shtml?rec=42

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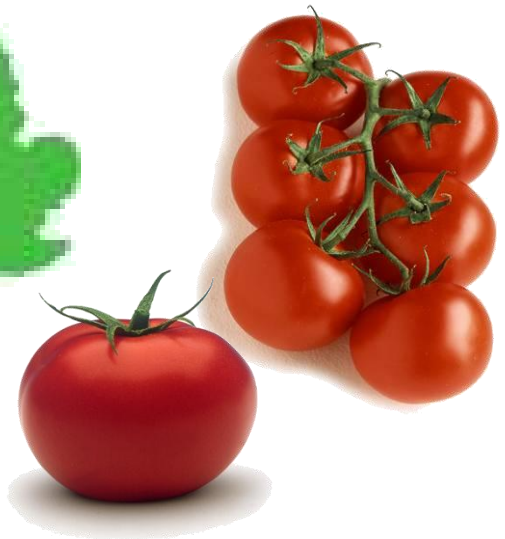
Linking flavor profiles to people (consumers)

Creating Consumer and Product Profiles

- As an example…

- …the UK consumer…



…and Standard/Cluster tomatoes.

round tomatoes of 100-130 gms

Consumer Sample n = 146

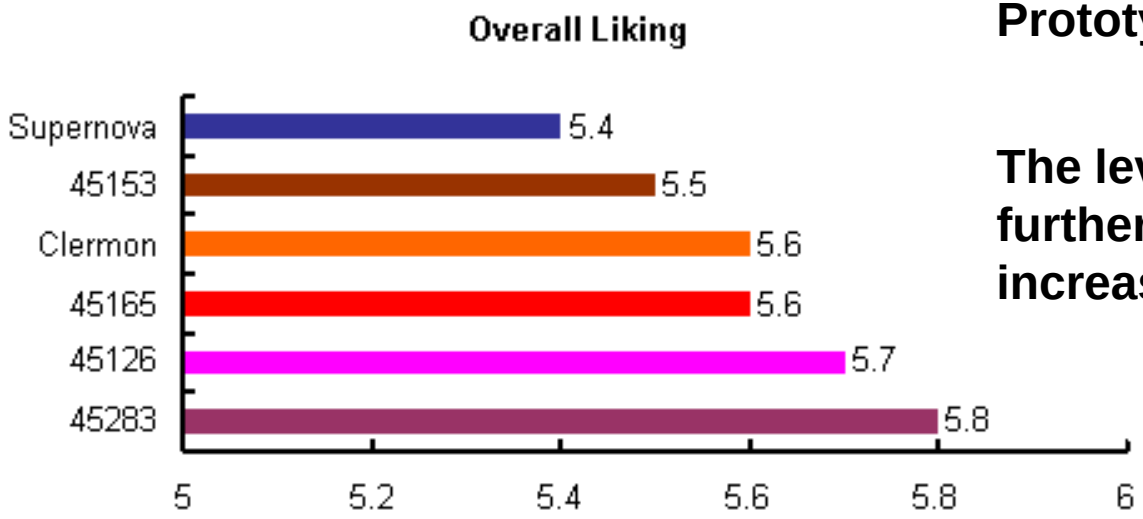
146 consumers completed the CLT at ‘Sensory Dimensions’ facility in Reading between the 5th to 28th June 2007.

- The sample comprised a slightly higher proportion of females at 55%, a fairly even spread in age from 18 to 65+.

- Around two thirds of the sample did the main grocery shop themselves for their household
  - most of the remainder sharing the responsibility equally.

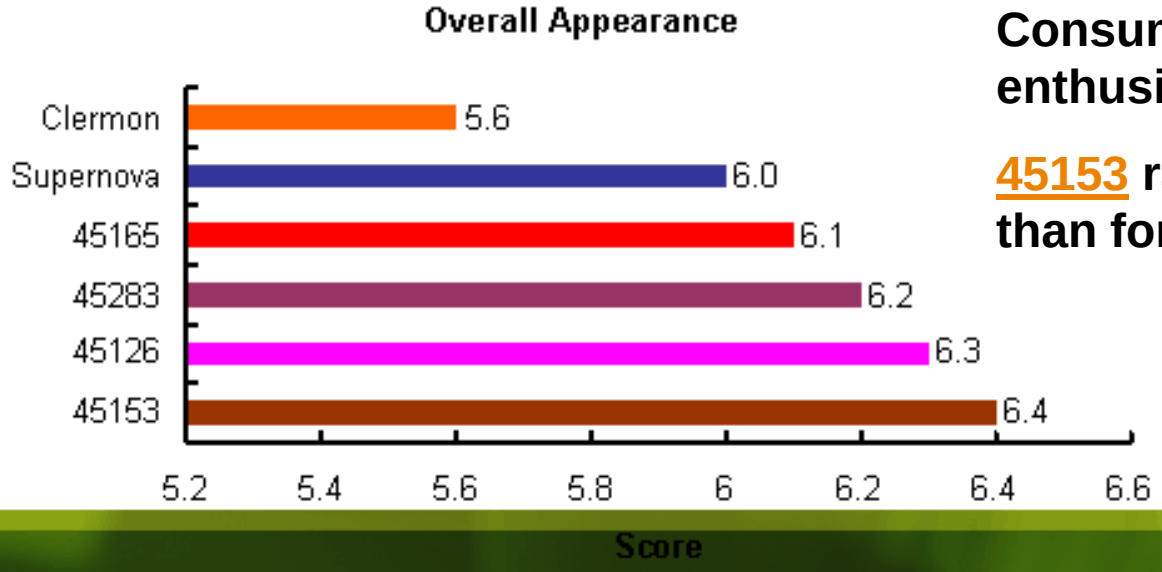
- Tested consumer acceptability of 25 different cluster varieties

Overall Liking and Appearance (9 point scale)



Prototype 45283 was the most liked.

The level of liking at 5.8 is quite low; further improvements would increase appeal.



Consumer responses were more enthusiastic for fruit appearance.

45153 rated better for appearance than for overall liking.

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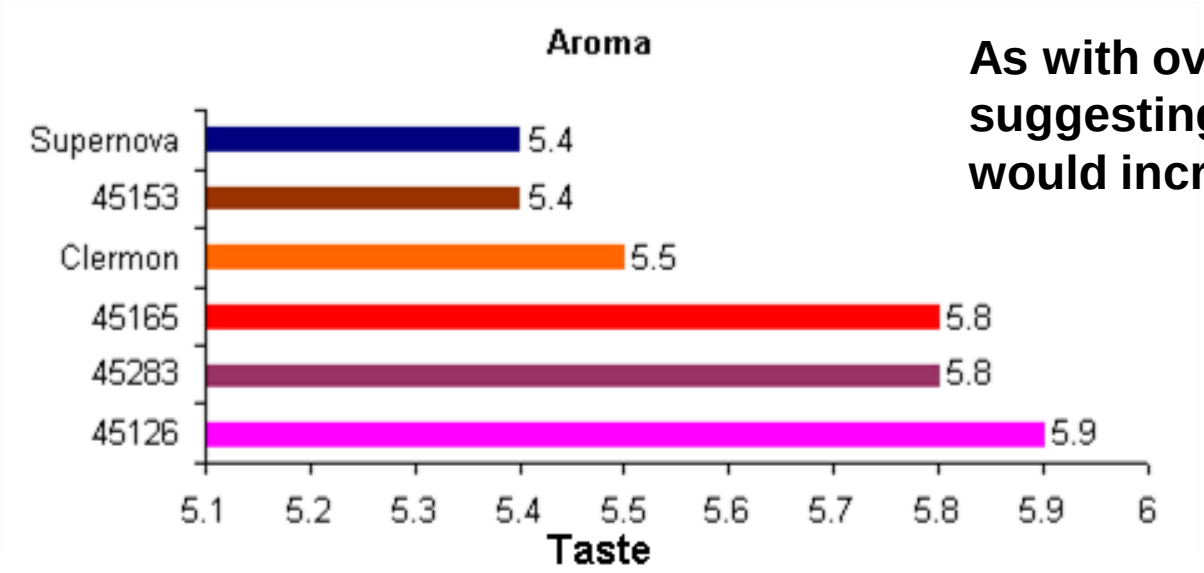
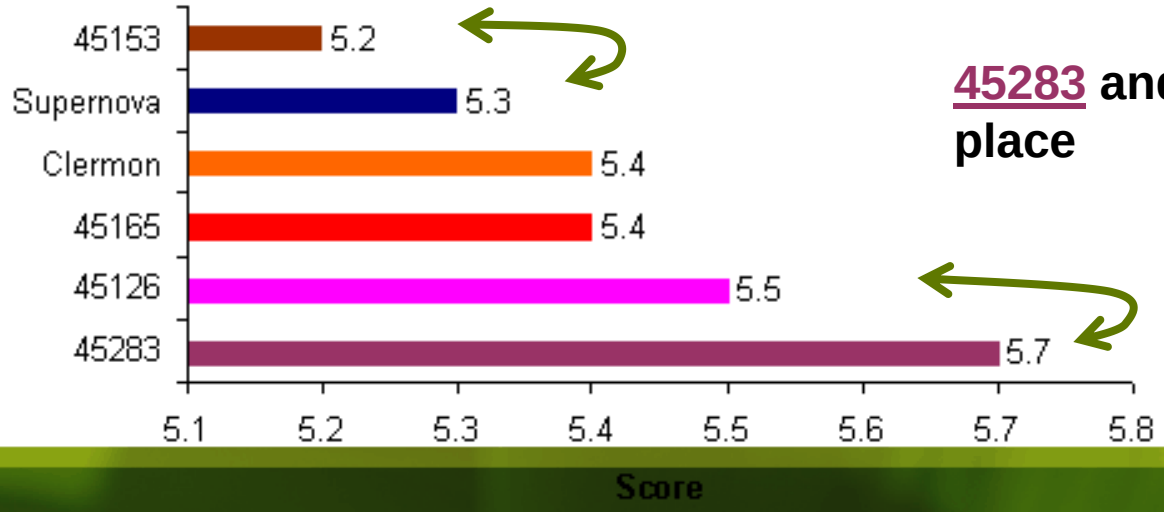
Aroma and Taste liking (9 point scale)



As with overall liking scores are low suggesting further improvement would increase appeal



45283 and 45126 compete for first place

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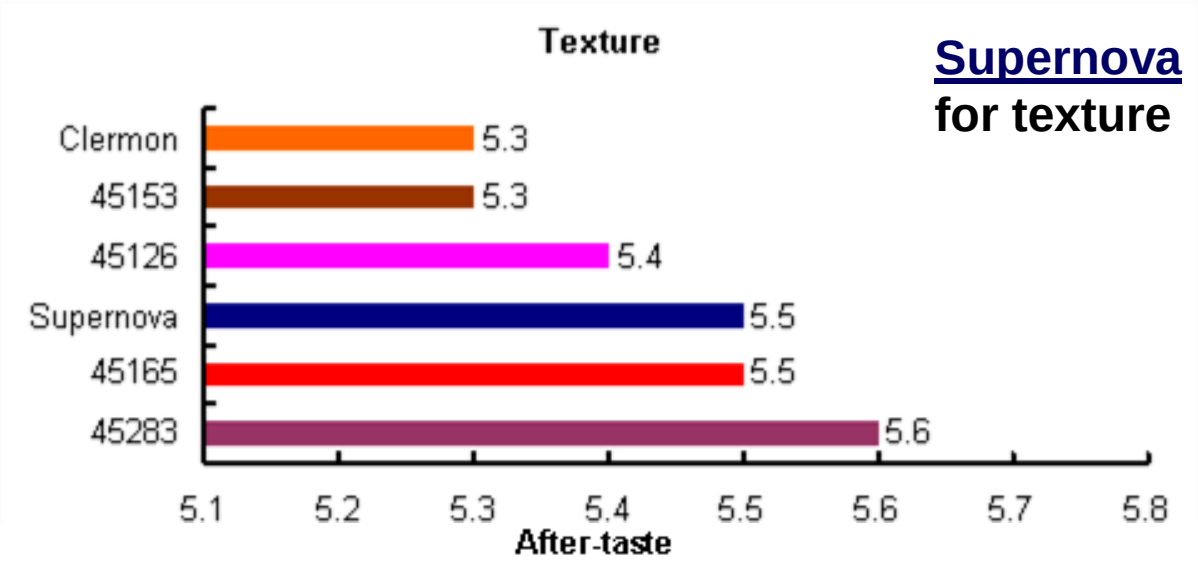
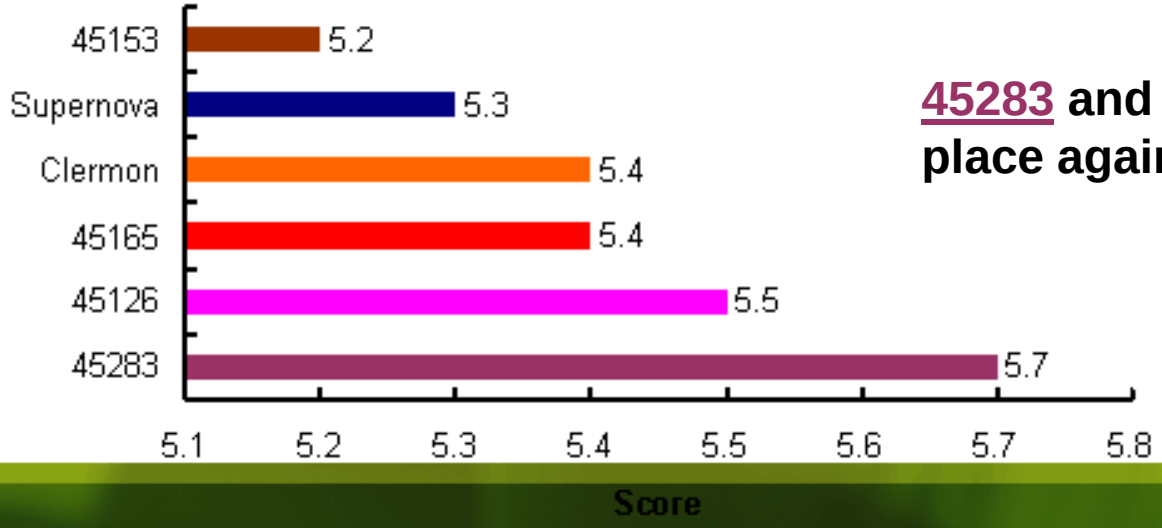
Texture and After-taste liking (9 point scale)



Supernova is much better appreciated for texture



45283 and 45126 compete for first place again

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Cluster Analysis (or Consumer Profiles)

Based on the liking data three consumer clusters where found

The clusters explain acceptance scores for 98% of consumers

Each cluster is typified by a set of tomato characteristics that drive acceptance of products

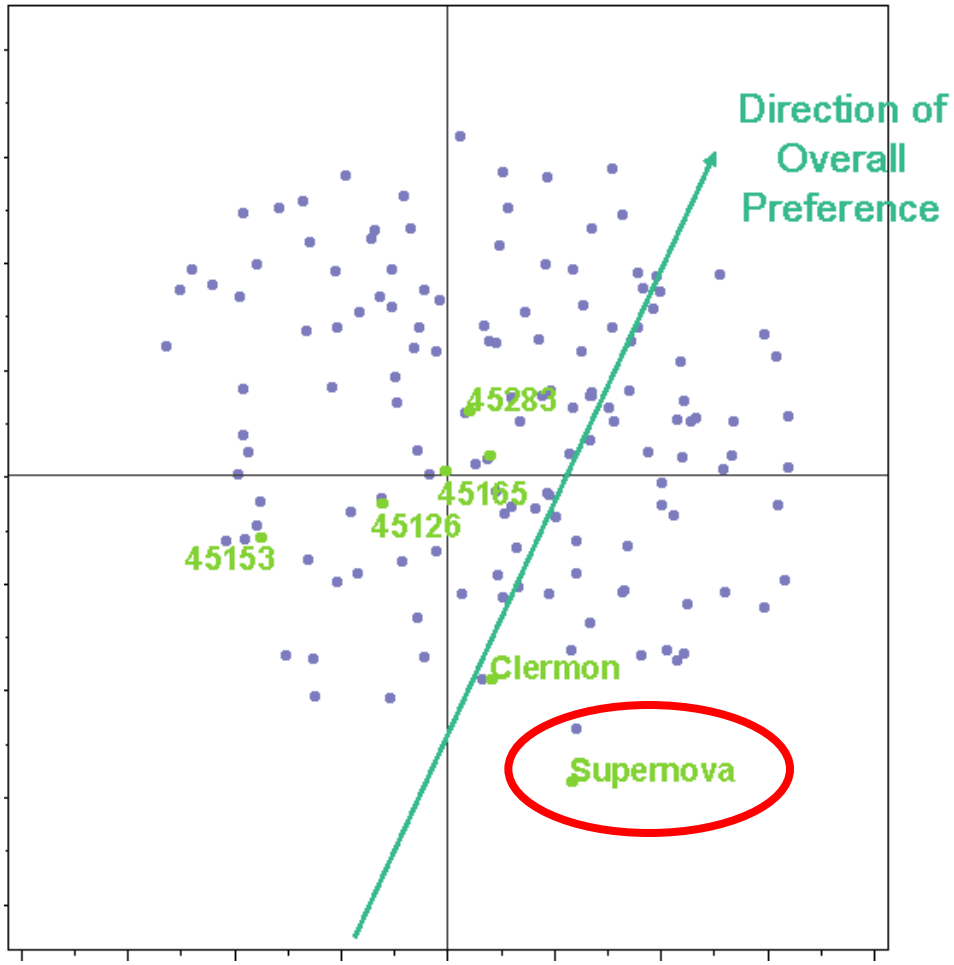
From this data we begin to see the characters to target for improving consumer acceptance

UK Consumer clusters

Cluster	One (46%)	Two (30%)	Three (22%)
Fruit characteristics	Ripe fruit, soft feel, distinctive flavor	Crisp texture, full fruity flavor	Fruit with character, good texture and taste balance
Positive drivers	Strength of flavor	Strength of flavor Tomato after taste Falvor balance	Skin persistence
Negative drivers	Feel, firm touch	Mealiness	None
Least like variety	Supernova (firm)		Clermon (skin)
Most appreciated	45283 (firmer)	Supernova (flavor)	Supernova, 45126, 45153

Internal Preference Mapping of Tomatoes

Preference is quite widely spread



Positive drivers

+ bright, uniform and deeper red (externally and internally).

+ a higher intensity of tomato fruit aroma and juiciness

+ more sweet, tomato fruit flavour

+ a good balance of flavour, neither too sweet nor acidic

Negative drivers

- **Mealiness of texture in particular is not liked.**
- **Tomato vine flavour (green)**
- **Bitter taste is not at all liked**

Consumer Profiles: Conclusions

- Flavour and texture (touch and mouth), take precedence over appearance in affecting overall acceptance and consequently consistency of choice

- Attitude towards preference within the UK market is quite diverse

  - need to provide several tomato varieties to meet the differing sensory quality requirements of the consumer.

- Out of the four development varieties 45283 performed best

  - its texture characteristics recording the most approval.

- Further sensory modifications are required to maximise acceptance

Developing products for consumers

As an Example: Products for Cluster 2 Consumers

Reminder… what do they want?

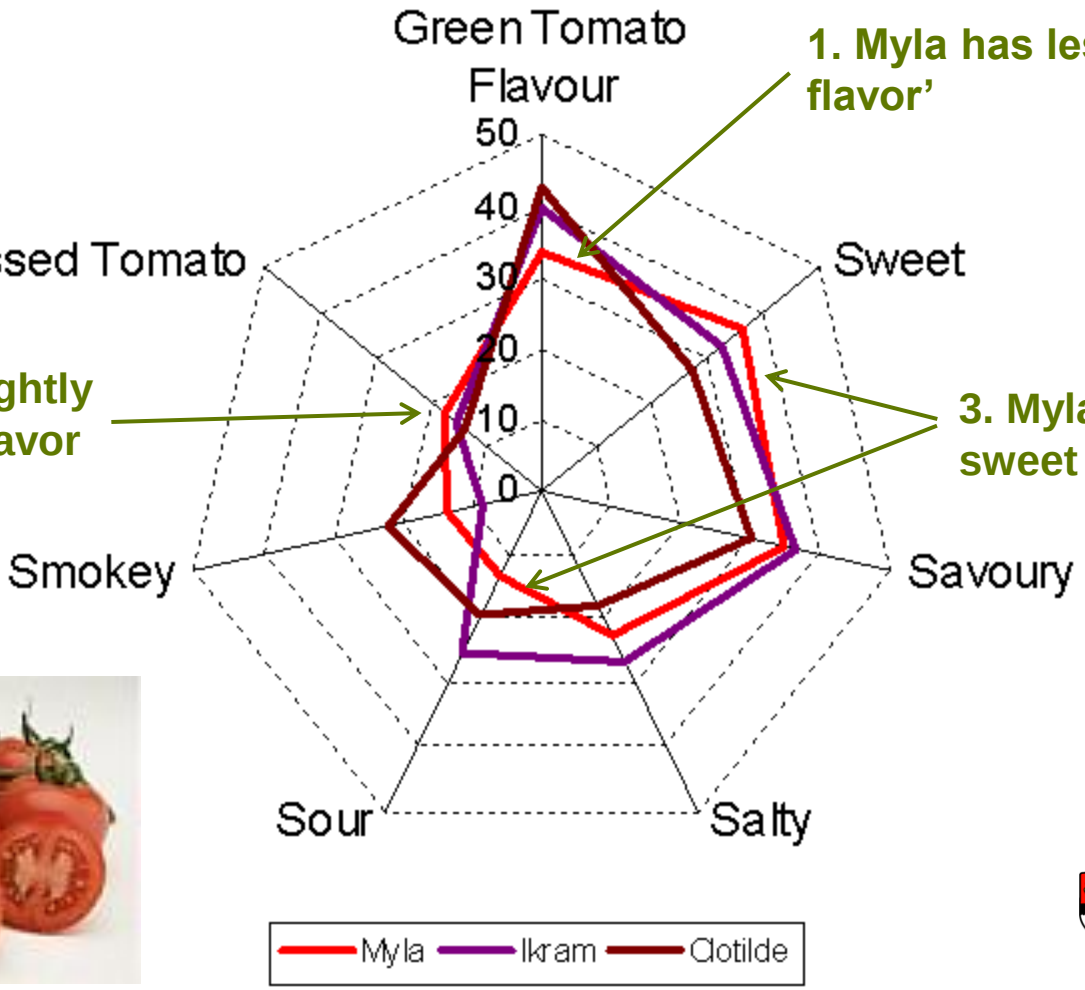
- A full, fruity and well balanced flavour is important for these consumers

Positive drivers:

Strength of tomato fruit flavour	0.52
Tomato fruit after taste	0.50
Balance of overall flavour	0.66

Products for Consumers in Cluster 2

Sensory Analysis Reveals Key Drivers in Potential Products



1. Myla has less 'green flavor'

2. Myla has a slightly higher tomato flavor intensity

3. Myla has a good sweet to sour balance

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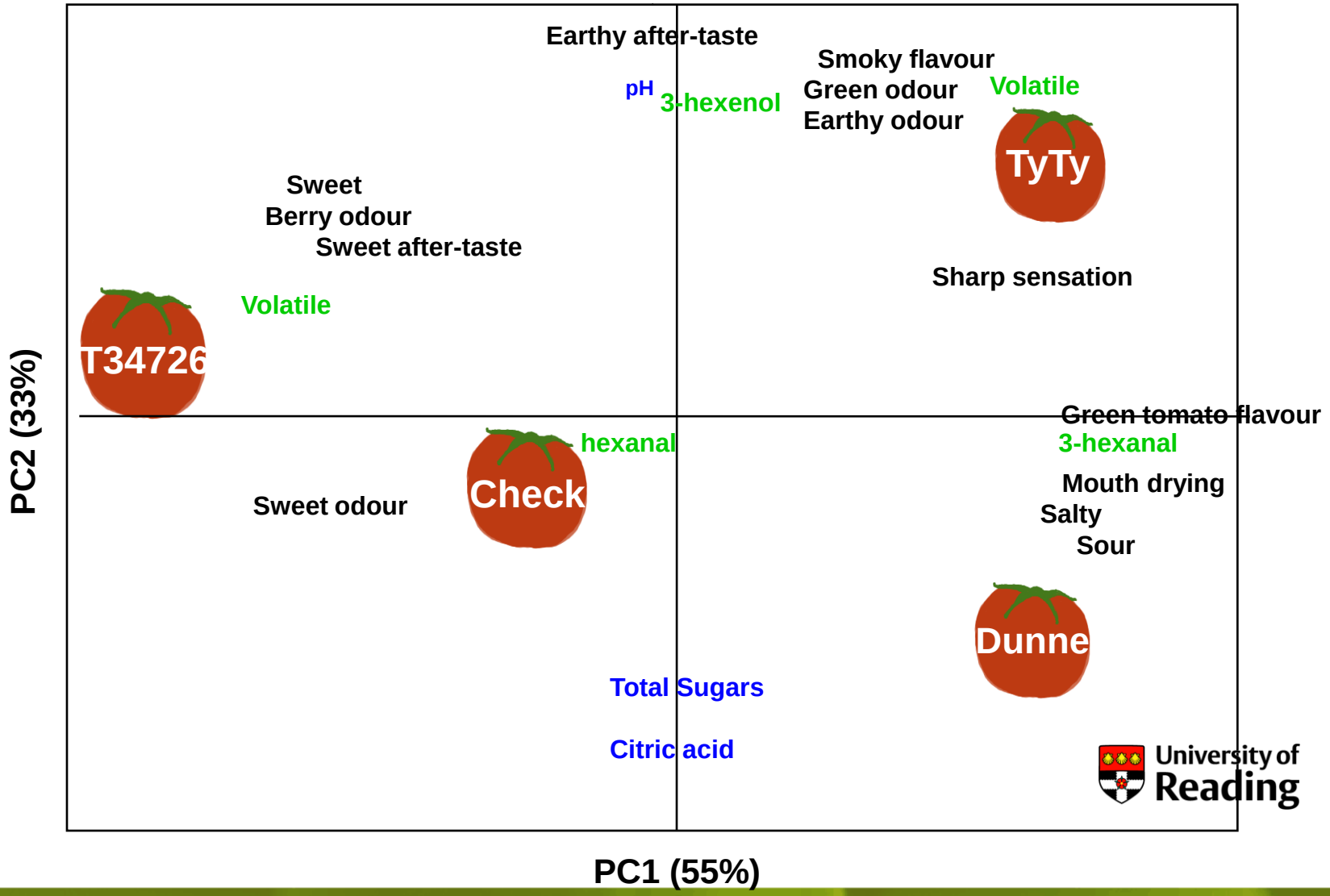
Combing Flavor Chemistry and Sensory Analysis



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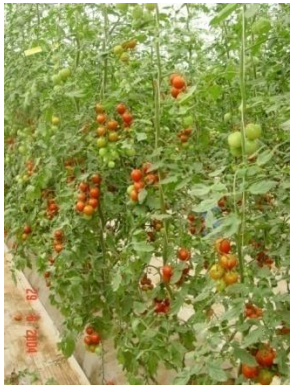
Using Analytical Tools to Discover Components

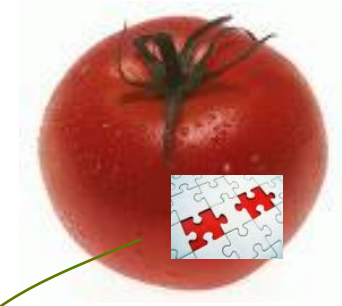
Screening tomato

In the Field



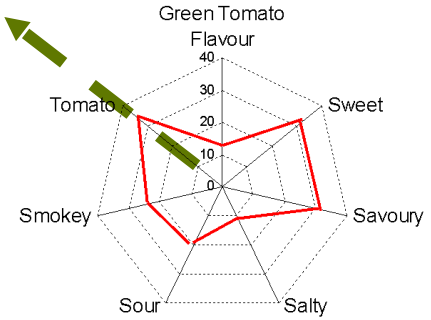
In the Lab

Discovering



Linking with consumer perception

Delivering



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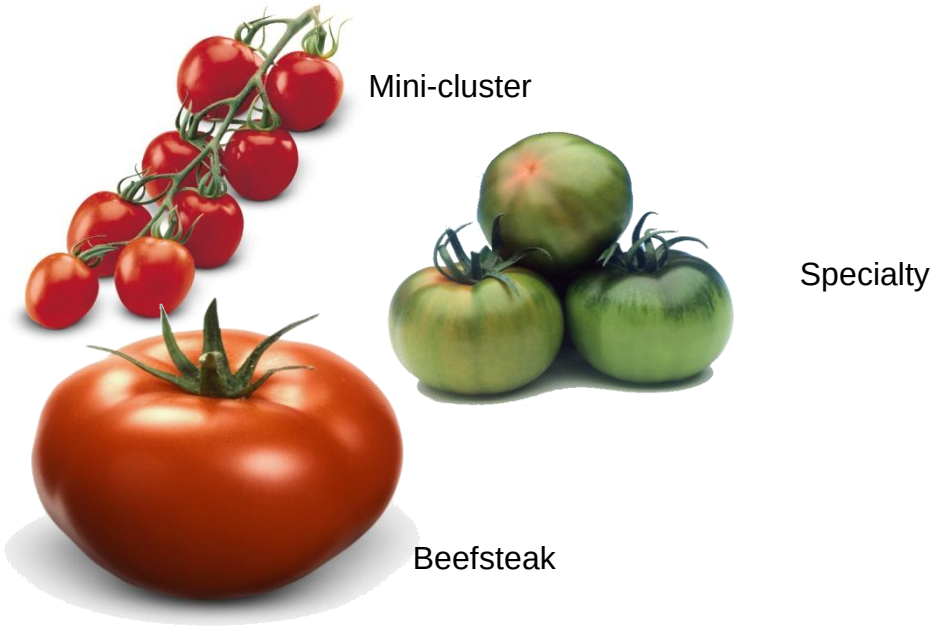
Concluding remarks

Broader Application

- The approach described focused on one country & segment
- The strategy is applicable to other countries & tomato segments



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Vegetables, Fresh Produce product innovation

- Integrated global technology network
  - strength in 14 major crops
  - leading native traits, marker-assisted breeding
  - >140 new varieties per annum
- Cross-regional sourcing
- Piloting downstream programs
  - taste, nutrition, convenience
  - retail branding

pureheart™

toscanella

SOLINDA™

gwanipa™

kumato™

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Summary

- Combining different disciplines allows us to focus on consumer requirements for tomato
- Analytical techniques allow us to translate sensory characters into the ‘flavor chemistry’ of tomato
- Knowledge of the flavor of tomatoes is allowing us to identify…
  - Products matching consumer requirements
  - Breeding materials to create superior products

The challenge is now to deliver this with the right communication to our ultimate customer

Bringing plant potential to life