

Formation of flavour along the cocoa value chain: its impact on quality of cocoa beans & products

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C A F É , C A C A O Y V I N O

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University St. Gallen



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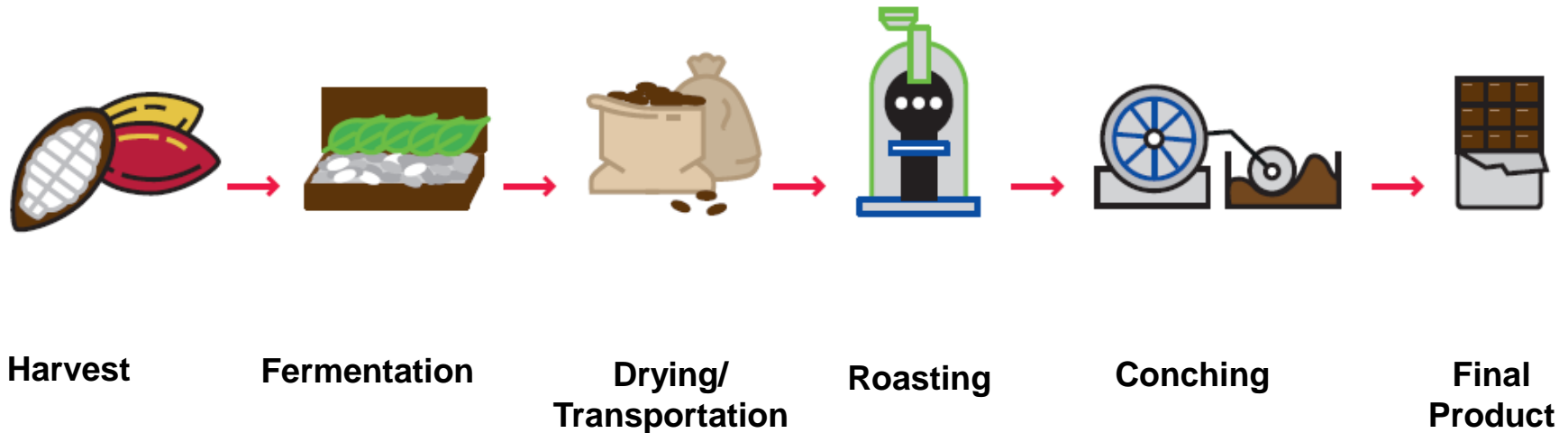


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Flavour development along the cocoa value chain

Flavour of chocolate might be regarded as final product of many different processing steps along the cocoa value chain



Flavour development along the cocoa value chain

review of scientific results on volatile compounds in cocoa products and chocolate intermediates

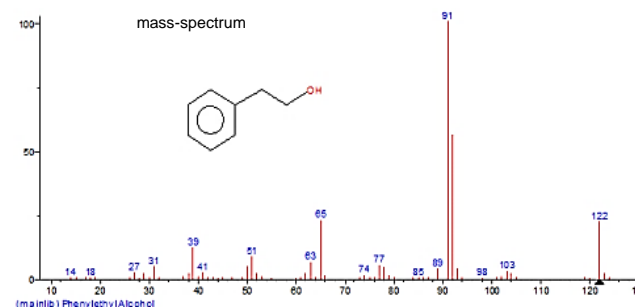
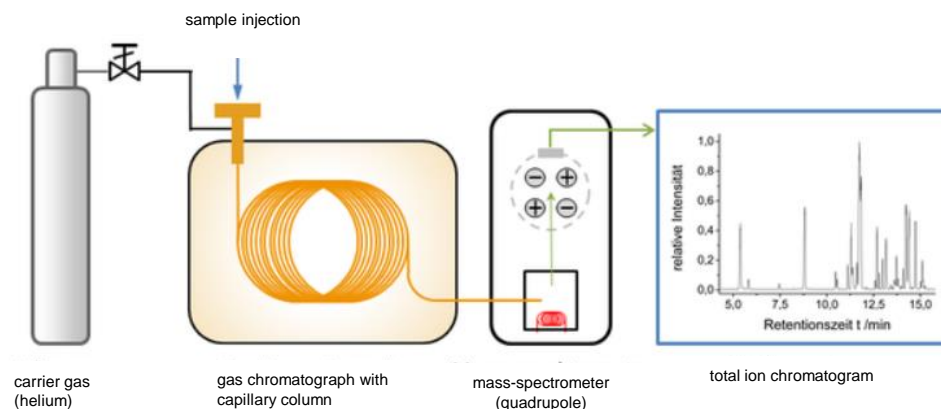
Product name	Volatiles
Cocoa Liquor	314
Cocoa Powder	314
Roasted Cocoa Beans	263
Dark Chocolate	118
Fermented Cocoa Beans	105
Cocoa Butter	123
Milk Chocolate	83
Cocoa category	684



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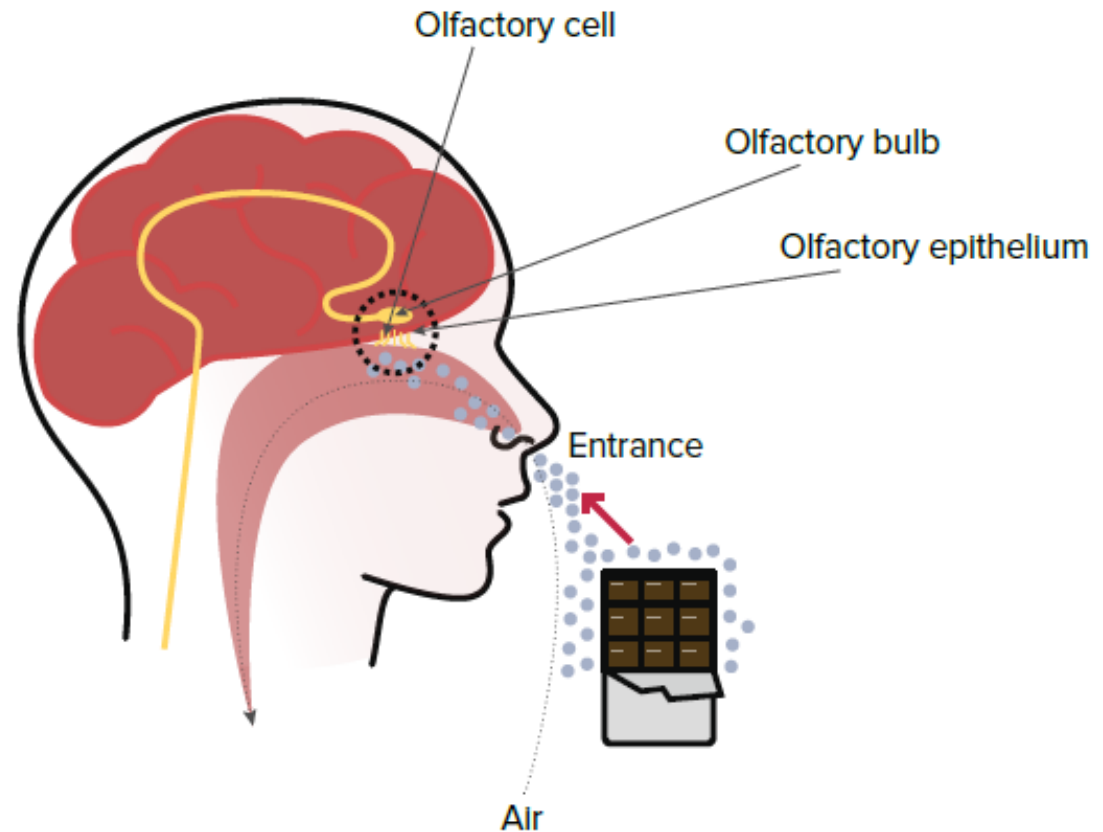
Cocoa & Chocolate key odorants	~ 50
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Perception of aroma-active compounds in cocoa & chocolate products:

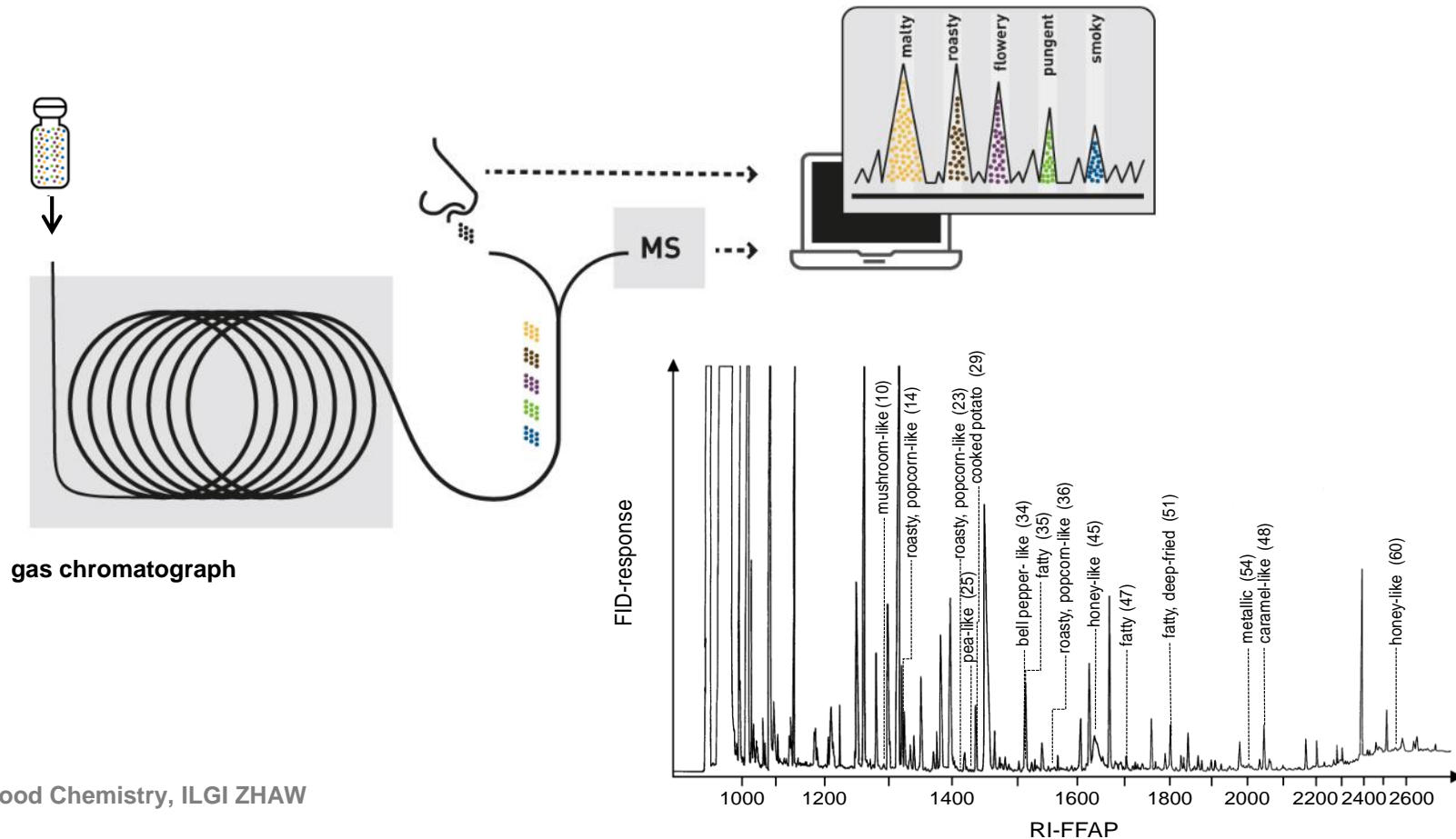
Aroma perception:

- key-odorants interact with 400 human odour receptors
- odour receptors located in the olfactory cells of the olfactory epithelium in the nasal cavity
- single key-odorants evoke different odour qualities such as flowery, fruity, which are perceivable in cocoa & cocoa products



Chemical characterisation of aroma-active compounds:

Identification of key odorants in cocoa by gas-chromatography coupled with olfactometry & mass spectrometry



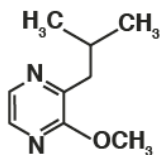
Cocoa key aroma compounds:



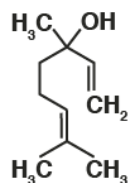
cocoa key aroma compounds:

- the orchestra of cocoa aroma
- the chemical odour code of cocoa

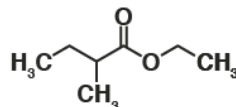
Cocoa & Chocolate key aroma compounds:



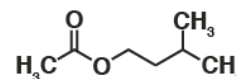
bell pepper-like



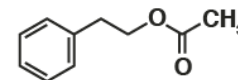
bergamot-like



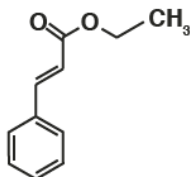
fruity



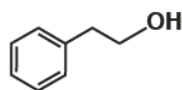
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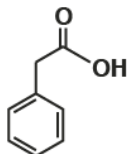
dried fruits, flowery



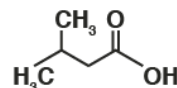
cinnamon-like



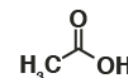
flowery, rose-like



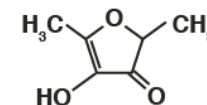
honey, beeswax-like



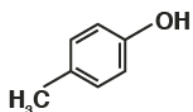
sweet, cheesy



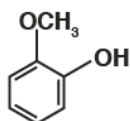
pungent



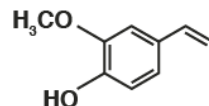
seasoning



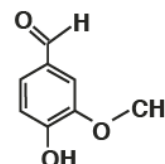
phenolic, horse-like



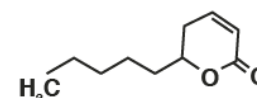
smoky



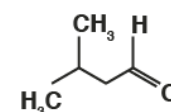
spicy, clove-like



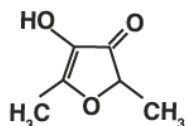
vanilla-like



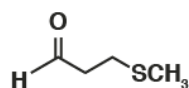
coconut-like



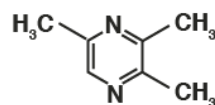
malty, cocoa-like



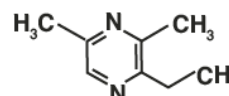
caramel-like



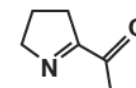
cooked potato-like



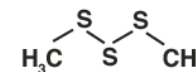
earthy, roasty



earthy

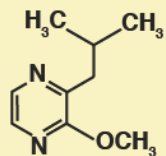


popcorn-like

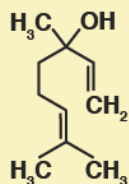


cabbage-like

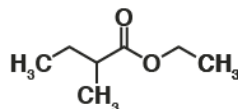
Cocoa & Chocolate key aroma compounds:



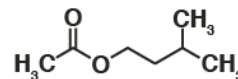
bell pepper-like



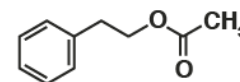
bergamot-like



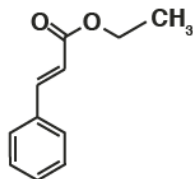
fruity



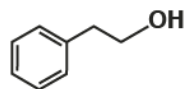
banana-like



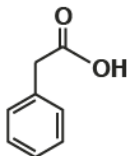
dried fruits, flowery



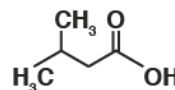
cinnamon-like



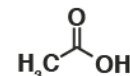
flowery, rose-like



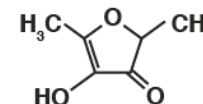
honey, beewax-like



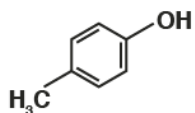
sweet, cheesy



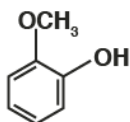
pungent



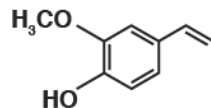
seasoning



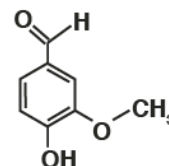
phenolic, horse-like



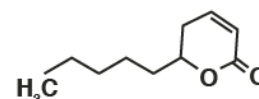
smoky



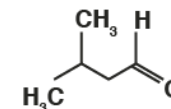
spicy, clove-like



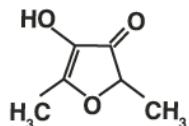
vanilla-like



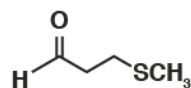
coconut-like



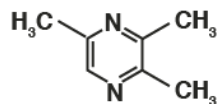
malty, cocoa-like



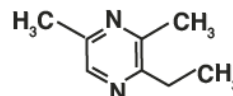
caramel-like



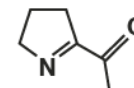
cooked potato-like



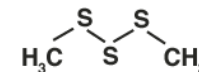
earthy, roasty



earthy

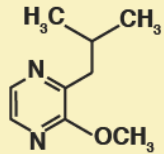


popcorn-like

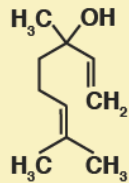


cabbage-like

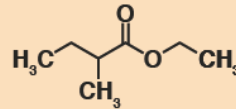
Cocoa & Chocolate key aroma compounds:



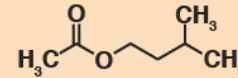
bell pepper-like



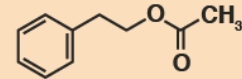
bergamot-like



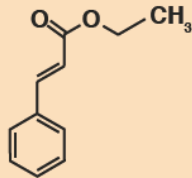
fruity



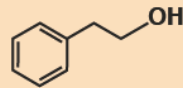
banana-like



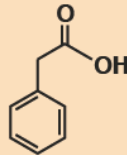
dried fruits, flowery



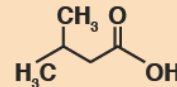
cinnamon-like



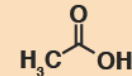
flowery, rose-like



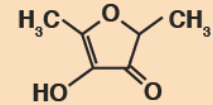
honey, beewax-like



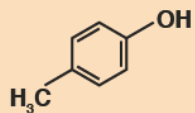
sweet, cheesy



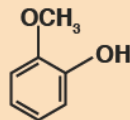
pungent



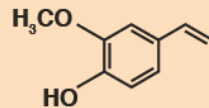
seasoning



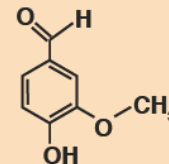
phenolic, horse-like



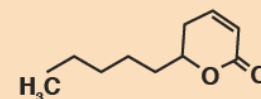
smoky



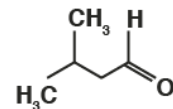
spicy, clove-like



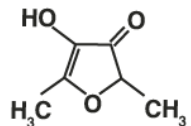
vanilla-like



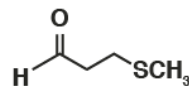
coconut-like



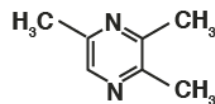
malty, cocoa-like



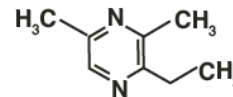
caramel-like



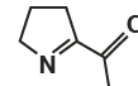
cooked potato-like



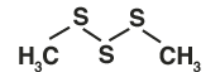
earthy, roasty



earthy

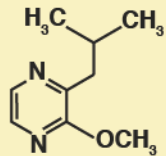


popcorn-like

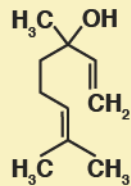


cabbage-like

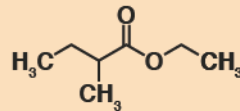
Cocoa & Chocolate key aroma compounds:



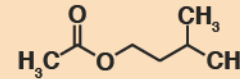
bell pepper-like



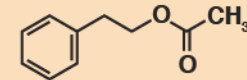
bergamot-like



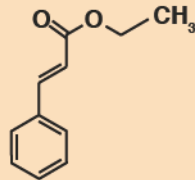
fruity



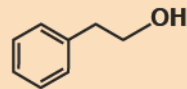
banana-like



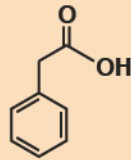
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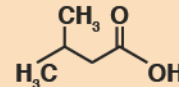
cinnamon-like



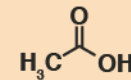
flowery, rose-like



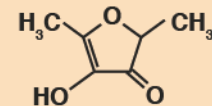
honey, beewax-like



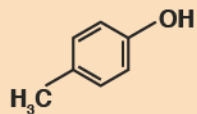
sweet, cheesy



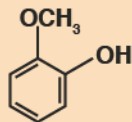
pungent



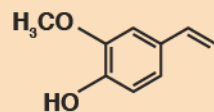
seasoning



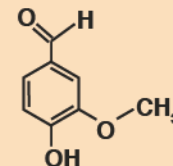
phenolic, horse-like



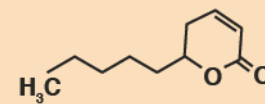
smoky



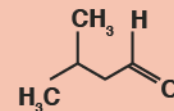
spicy, clove-like



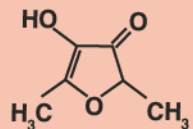
vanilla-like



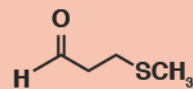
coconut-like



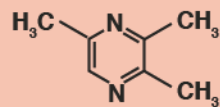
malty, cocoa-like



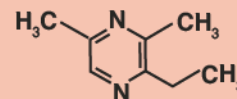
caramel-like



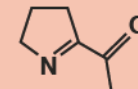
cooked potato-like



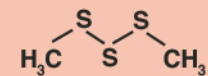
earthy, roasty



earthy



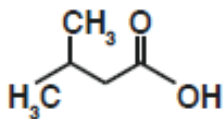
popcorn-like



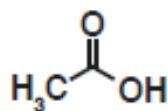
cabbage-like

Less desired cocoa aroma compounds:

volatile acids:



sweaty, cheesy

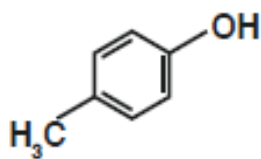


pungent

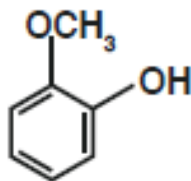


- in over-fermented cocoa beans
- removable through intense thermal processing of the cocoa beans

phenols:



phenolic, horse-like

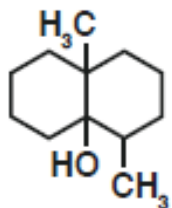


smoky

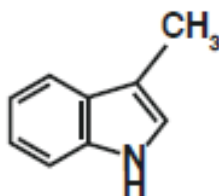


- in cocoa beans dried over wooden fires

other compounds:



beet root-like



faecal

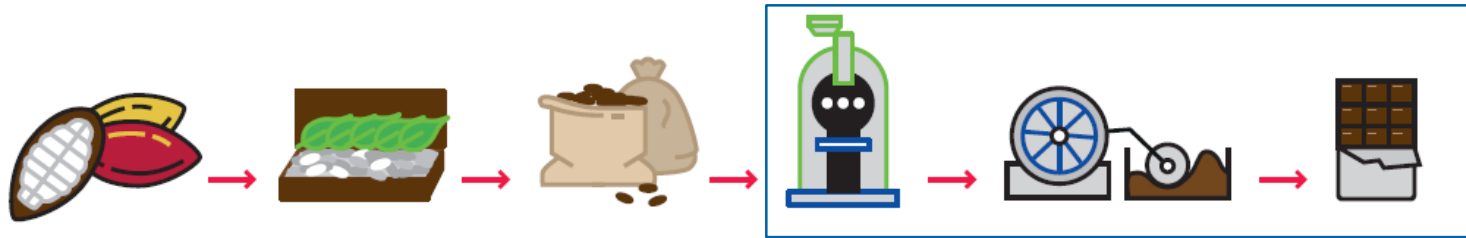


- in not appropriately fermented cocoa beans
- formed by yet unknown microorganisms

Perspectives of cocoa flavour research

in the past:

flavour research mostly done on intermediates/products produced in big industrial scale



focus: effect of technological processing on flavour → chocolate with constant flavour properties

rarely available systematical data on flavour properties as result of

- varieties, clones, country of origin
- different post-harvest treatments (fermentation & drying procedures)

Perspectives of cocoa flavour research

today:

- raising demand of consumers for flavourful, fair, sustainable and traceable products
- small batch producers scene is growing – awareness for novel cocoa flavour

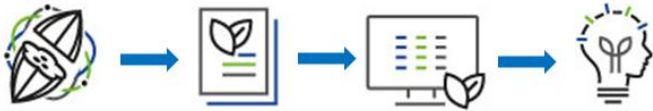


new research questions:

- how does the variety & post harvest processing impact the flavour/quality of cocoa and its products?
- how do agronomic conditions impact the flavour/quality of cocoa beans?
- how do social, ecological & economical conditions influence flavour/quality of cocoa and cocoa products?

Perspectives of cocoa flavour research

Cocoa in Numbers Project



Objective: set up of a data base tool to with the aim to promote

- transparency
- quality, safety & sustainability within the cocoa value chain

Next steps:

studying flavour properties of selected small batch chocolates (produced of cocoa beans of a defined origins) as result of agronomic conditions, processing and social aspects



Interdisciplinary project funded by ZHAW, Department N






ILGI – Institute of Food and Beverage Innovation, ZHAW, Wädenswil, Switzerland

IUNR – Institute of Natural Resource Sciences, ZHAW, Wädenswil, Switzerland

IAS – Institute of Applied Simulation, ZHAW, Wädenswil, Switzerland

FIBL - Research Institute of Organic Agriculture, Frick, Switzerland

Model experiments: analysis of the impact of 3 different agronomic conditions on selected dimensions along the cocoa value chain

monoculture conventional					
monoculture organic					
agroforestry organic					
Cultivation Bolivia - Sara Ana (FIBL) Monika Schneider	Post-harvest Treatment Bolivia – Sara Ana (FIBL/ZHAW - ILGI) Susanne Miescher Schwenninger	Processing & Characterisation (ZHAW- ILGI) Wädenswil Irene Chetschik & Karin Chatelain			
Agronomic factors: <ul style="list-style-type: none"> • pest incidence • shade level • humidity • temperature 	Post-harvest monitoring over time: <ul style="list-style-type: none"> • microbiota • sugars & acids • temperature, pH, moisture, cut-test 	Sensory Analysis <ul style="list-style-type: none"> • QDA quantitative descriptive analysis of selected cocoa & chocolate flavour attributes 			
		Chemical characterisation: <ul style="list-style-type: none"> • quality markers: flavour compounds & polyphenols • safety markers: cadmium & mycotoxins 			
		Social analysis (ZHAW – IUNR) Sonja Trachsel			
		Life cycle assessment (ZHAW – IUNR) Mathias Stucki			
		Analysis of regulative and normative requirements (ZHAW – ILGI) Sylvia Wick			

Outlook & Take home message:

although a lot of research has been conducted on the flavours & quality of cocoa, there is still a lot to do, especially for interdisciplinary teams

with the aim to foster:

- transparency within the cocoa value chain
- fair cocoa farming
- biodiversity of cocoa
- quality, safety & sustainability of cocoa

→ benefit for all involved stakeholders

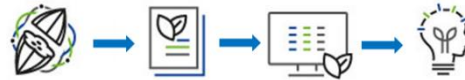


Thank you:

Team Research Group Food Chemistry ZHAW

Amandine André
Lisa Ullrich
Markus Kneubühl
Ansgar Schlüter
Sandra Panarese
Katrín Jedrys
Bettina Casty

Team Cocoa in Numbers:



Karin Chatelain
Susanne Miescher
Schwenninger
Sonja Trachsel
Monika Schneider
Robert Vorburger
Mathias Stucki
Sylvia Wick



Thank you for your kind attention!

