ROBERTET

Cafés Malongo

Journée du Club d'Expertise Chimique de Mediterranée 2007 06 19

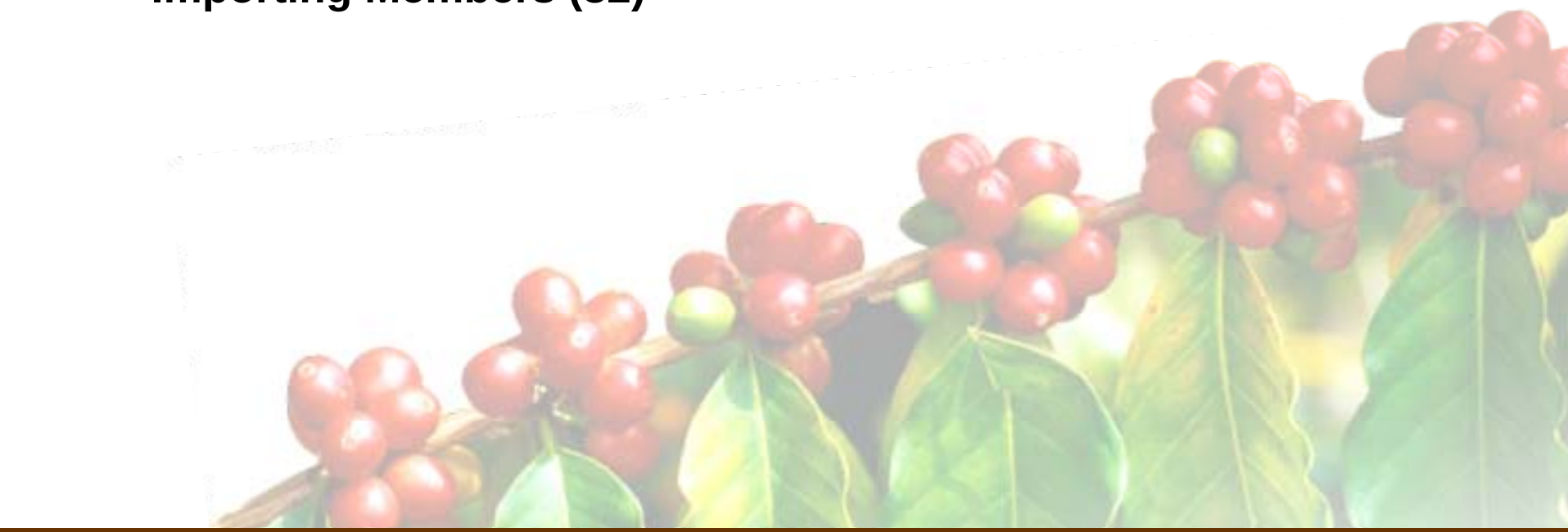
Hugues BREVARD

International Coffee Organisation

Members of the International Coffee Agreement 2001
(as at 27 March 2007)

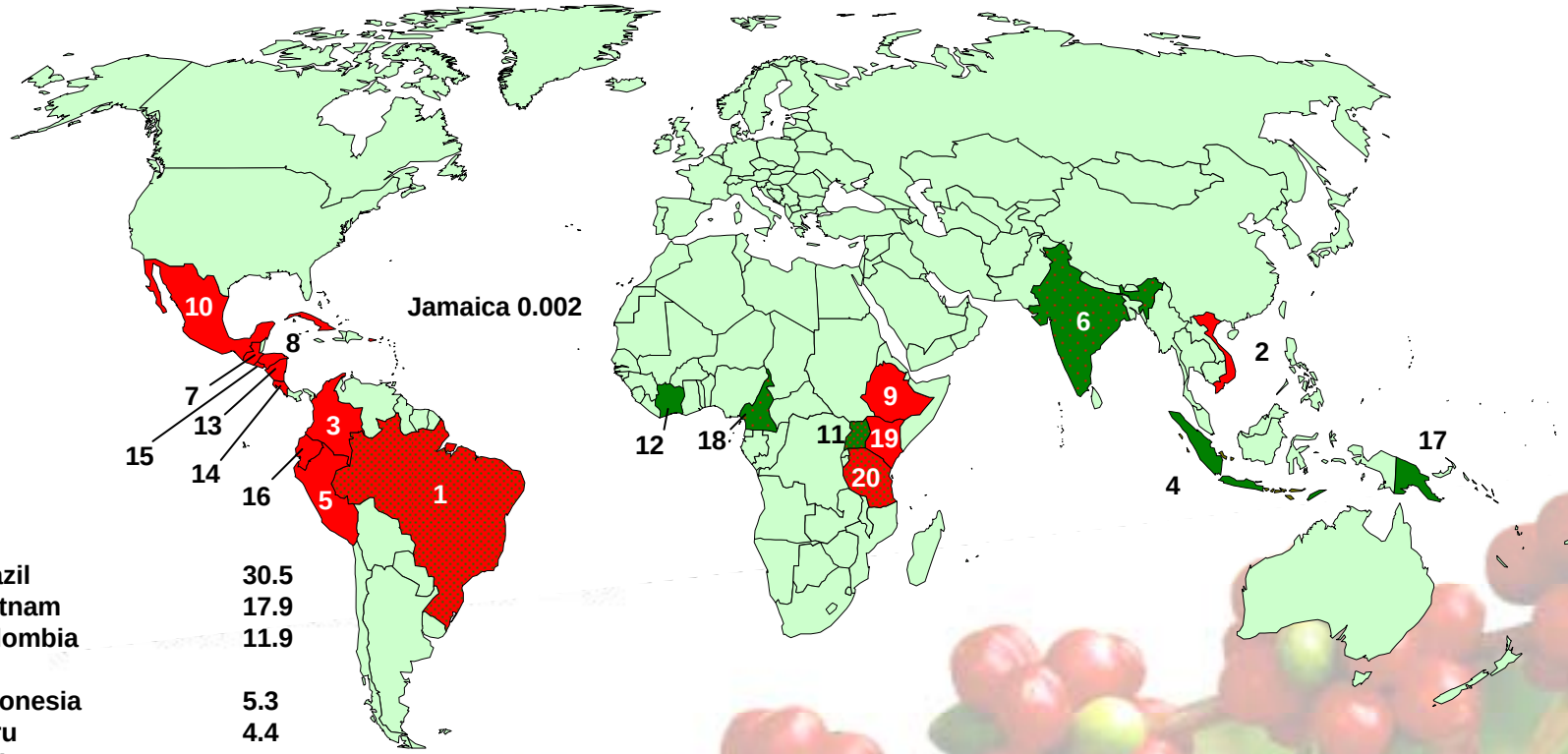
77 Members

- **Exporting Members (45)**
- **Importing Members (32)**



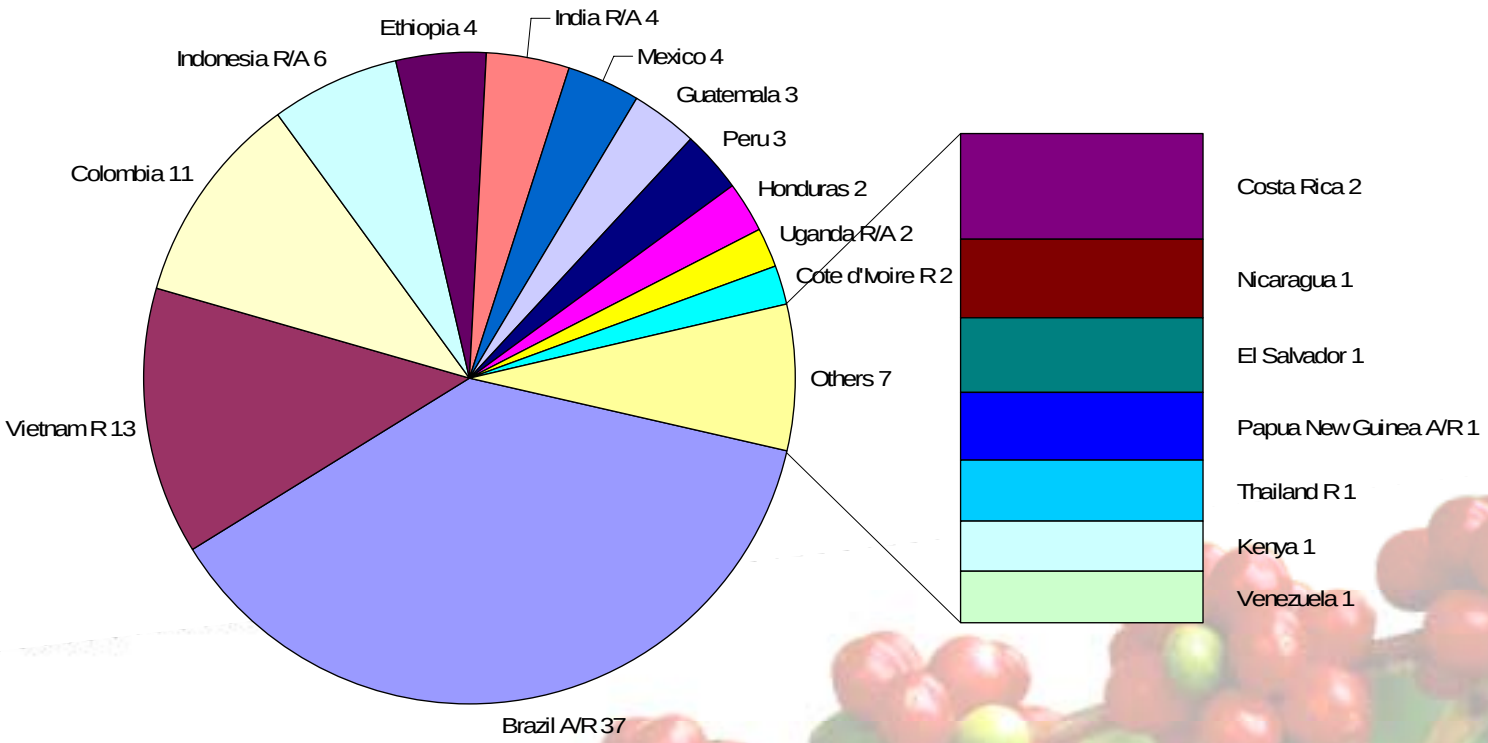
Coffee producer countries - 2005

% World production



1.	Brazil	30.5
2.	Vietnam	17.9
3.	Colombia	11.9
4.	Indonesia	5.3
5.	Peru	4.4
6.	India	4
7.	Guatemala	3.7
8.	Honduras	3.1
9.	Ethiopia	3
10.	Mexico	3
11.	Uganda	2.6
12.	Ivory Coast	2.4
13.	Nicaragua	1.5
14.	Costa Rica	1.4
15.	El Salvador	1.4
16.	Ecuador	1.1
17.	Papua NG	0.9
18.	Cameroon	0.8
19.	Kenya	0.7
20.	Tanzania	0.6

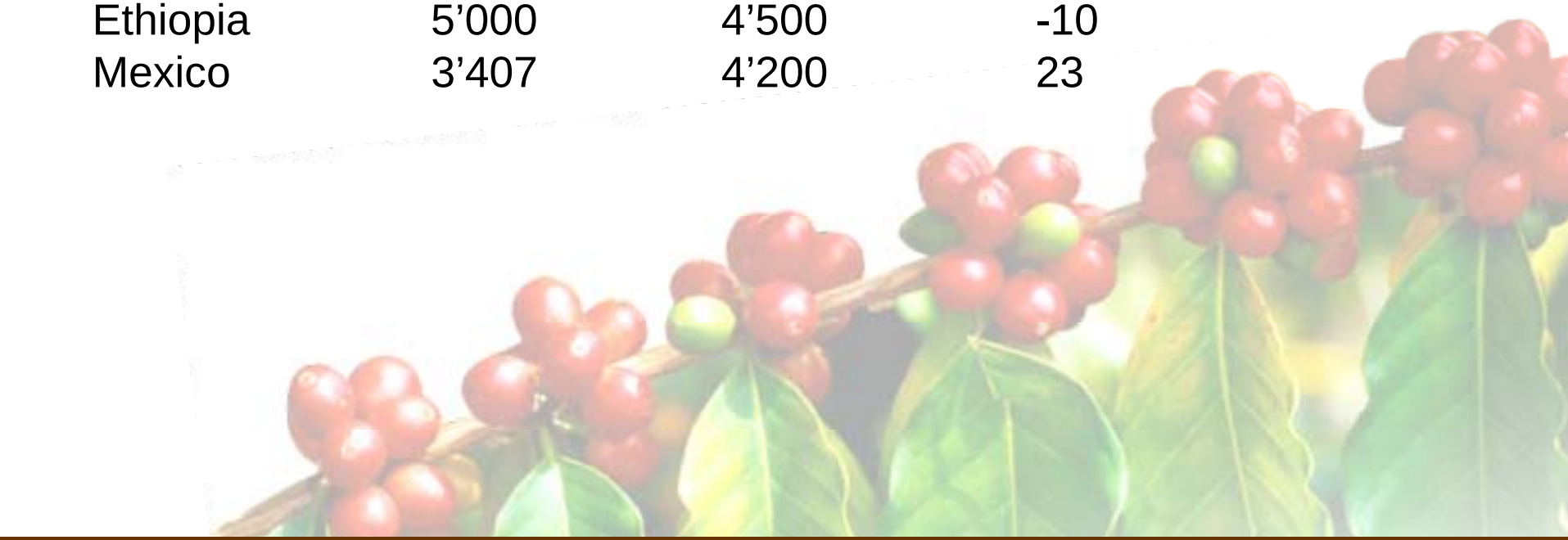
Coffee producer countries - 2006



% World production
WP 122 M bags
7 M tons

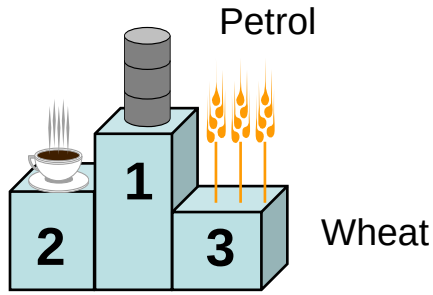
Variation in production

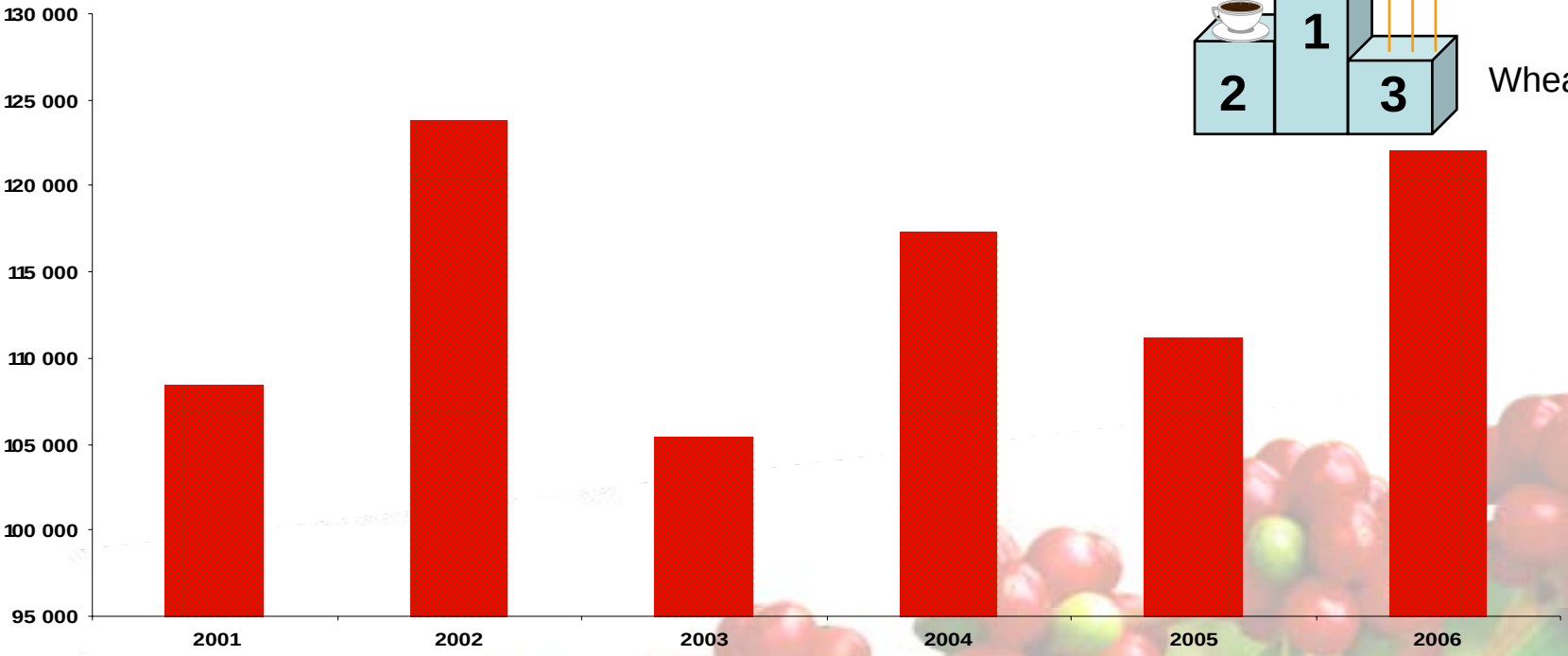
	2004	2005	Δ
Brazil	39’272	32’944	-16
Vietnam	13’844	11’000	-21
Indonesia	7’386	6’750	-9
India	3’844	4’630	20
Ethiopia	5’000	4’500	-10
Mexico	3’407	4’200	23



World production

Coffee is the second most important world trade product





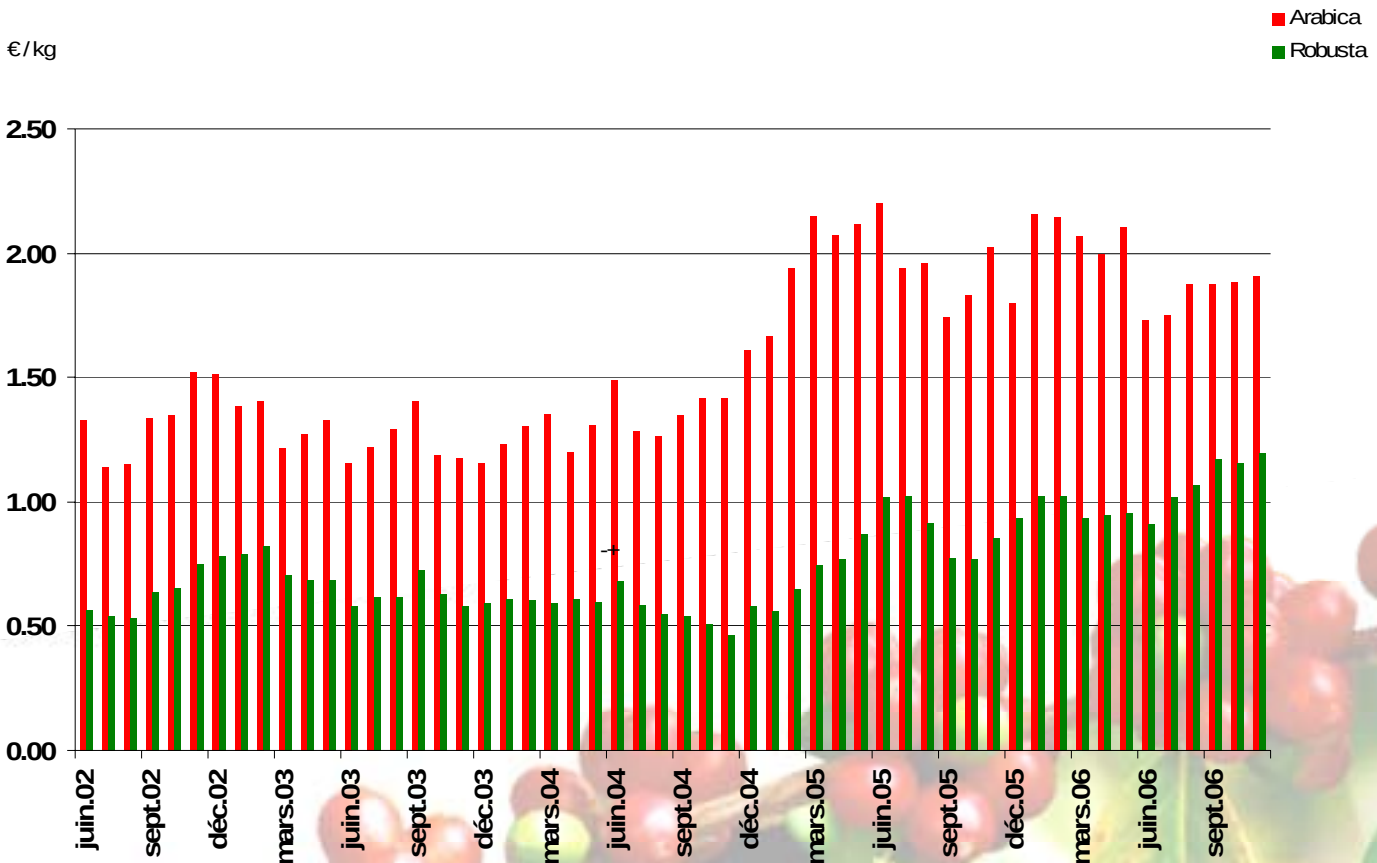
Coffee price evolution

Arabicas +27%
Robustas +71%

US cents/lb

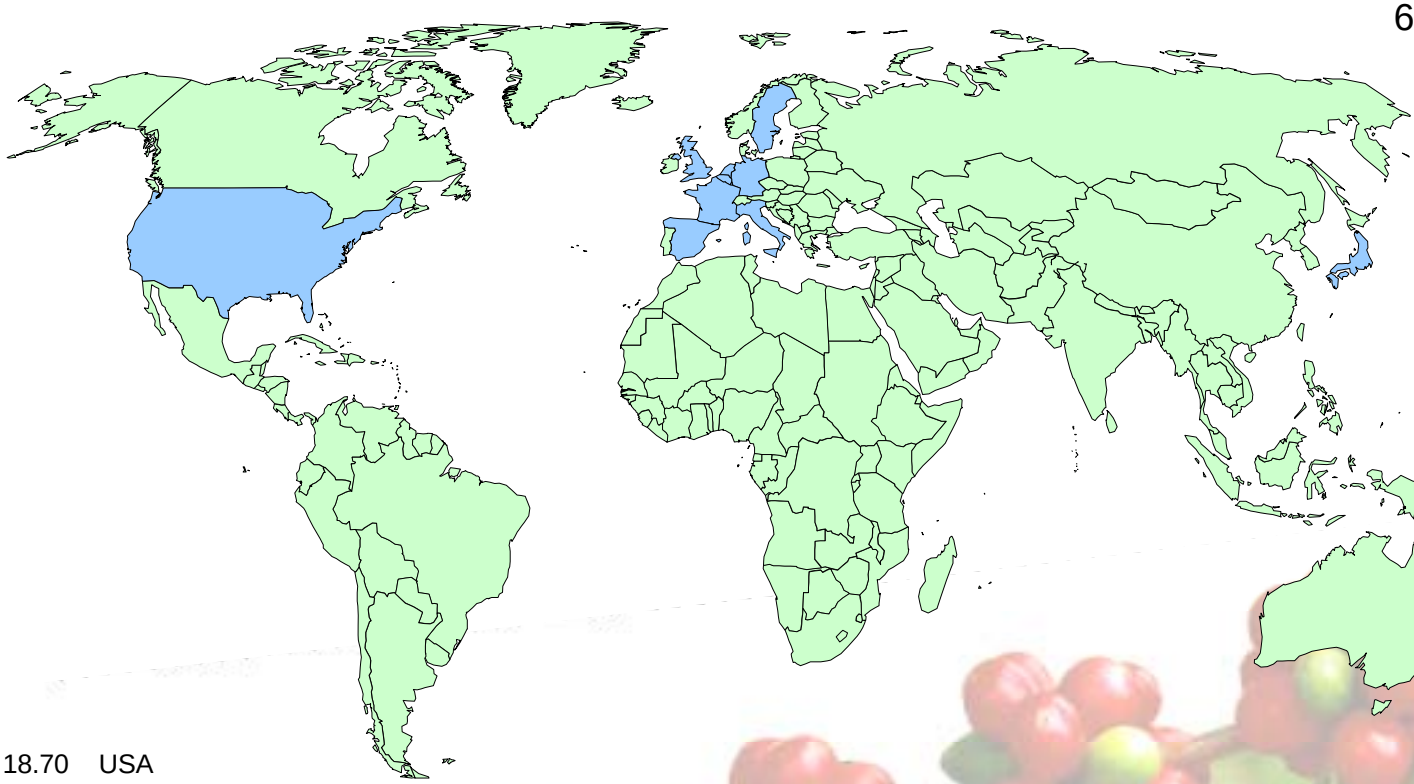
Coffee price evolution

2002-2006



Coffee consumption by importing country

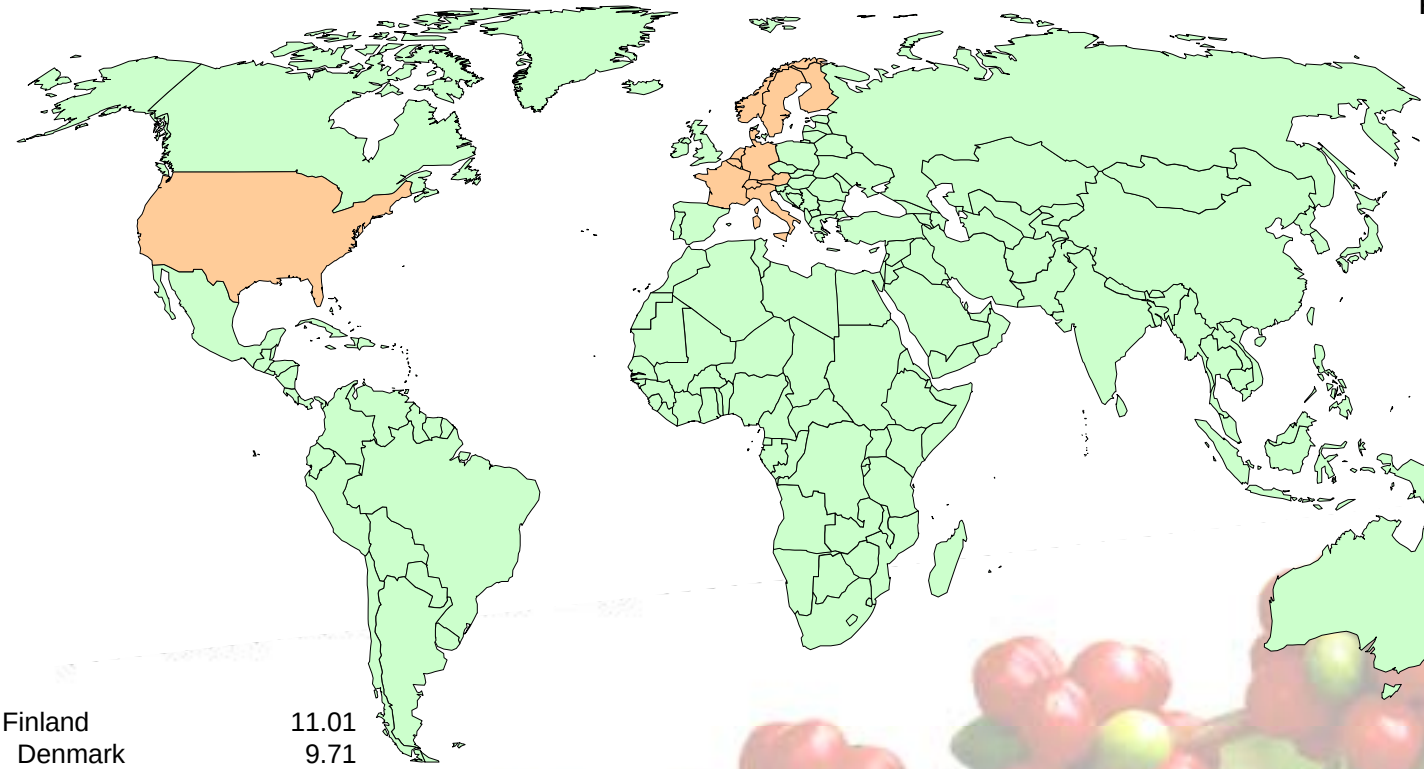
Crop 2002-2003
60 kg bags



1	18.70	USA
2	9.14	GER
3	6.96	JPN
4	5.39	FR
5	5.21	I
6	2.97	SP
7	2.20	UK
8	1.63	NL
9	1.27	B-L
10	1.25	S

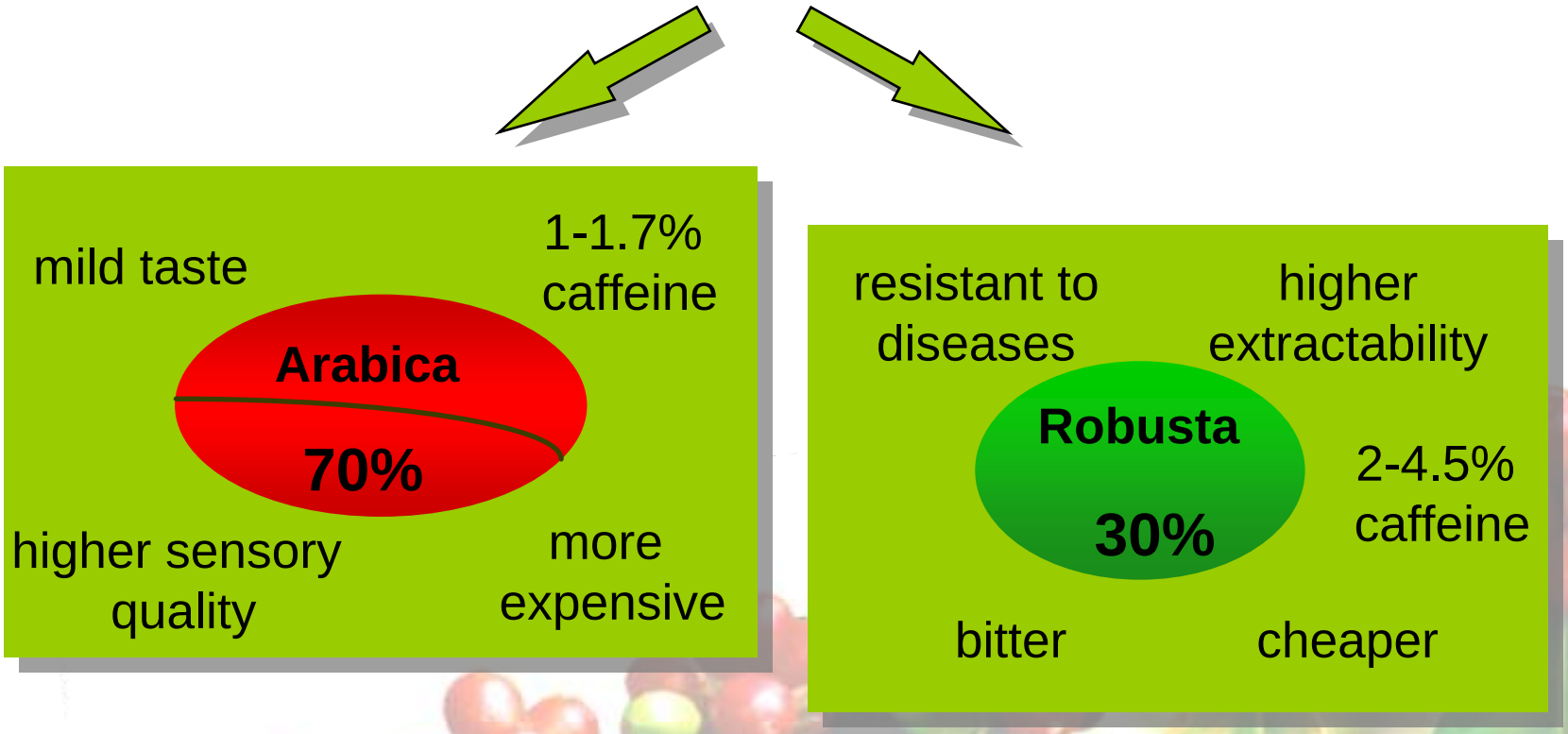
Top 12 Coffee country consumers

2001
kg / person



1	Finland	11.01
2	Denmark	9.71
3	Norway	9.46
4	Sweden	8.55
5	Austria	7.79
6	Germany	6.90
7	Switzerland	6.80
8	Holland	6.48
9	Belgium	5.53
10	Italy	5.44
11	France	5.31
12	US	4.09

COFFEE

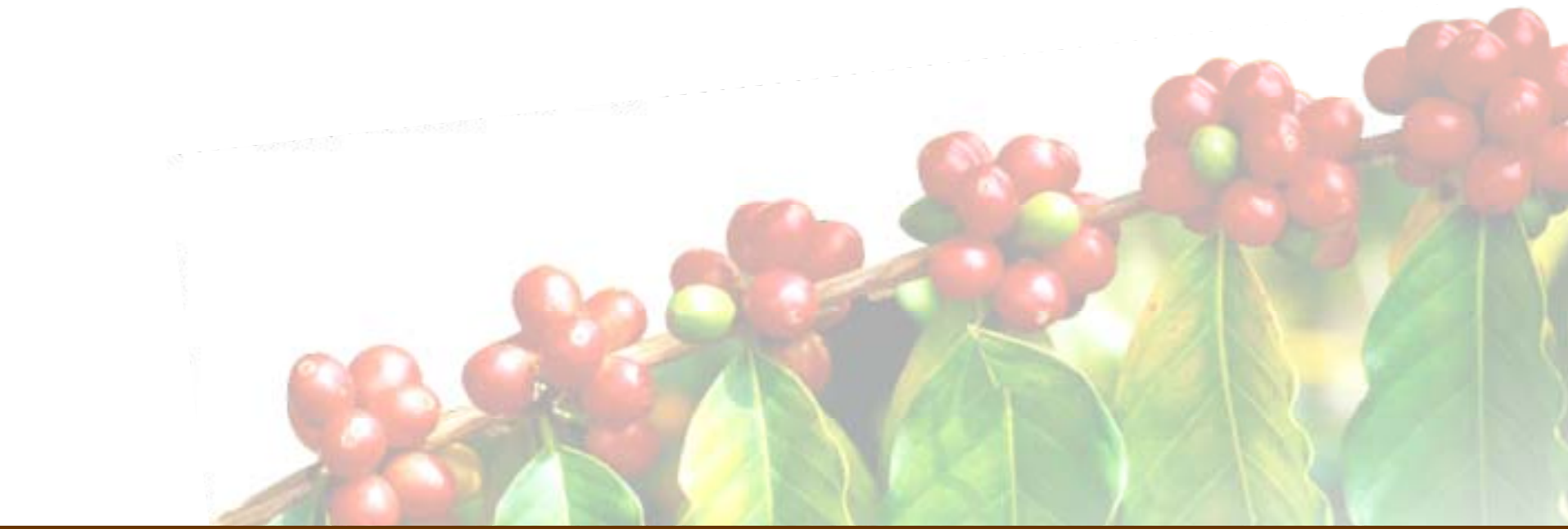

mild taste
1-1.7% caffeine
Arabica
70%
higher sensory quality
more expensive
resistant to diseases
higher extractability
Robusta
30%
2-4.5% caffeine
bitter
cheaper

Coffee classification

Rubiaceae familly

Coffea arabica L.

Coffea canephora Pierre



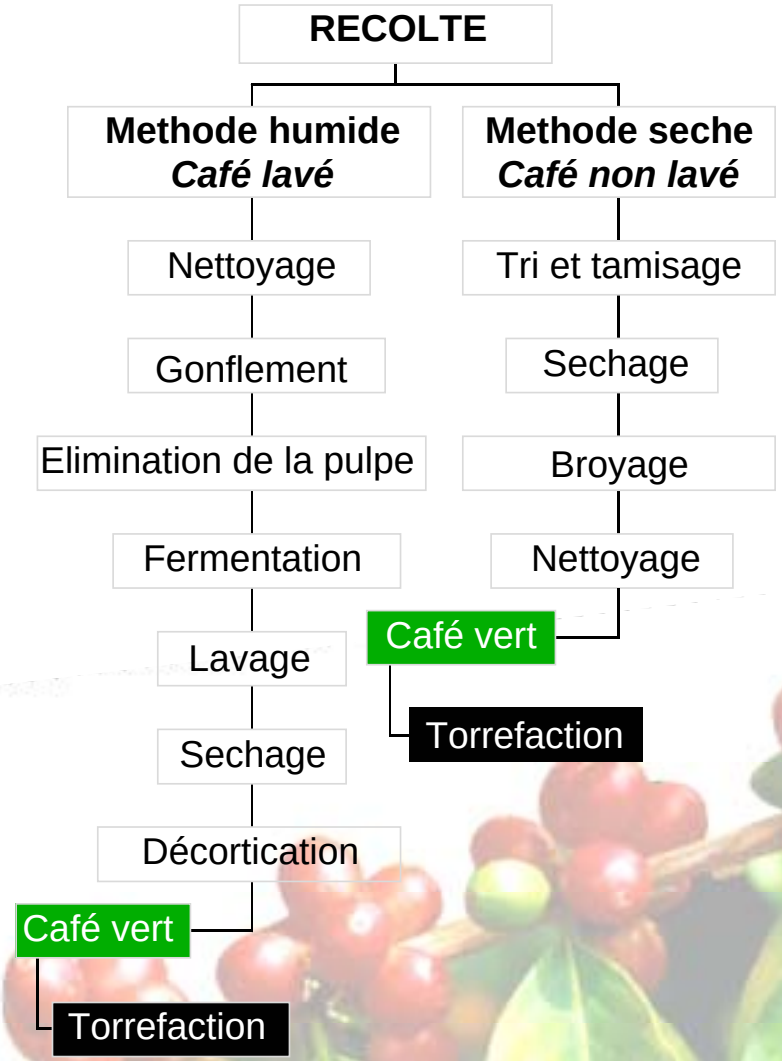
Coffee species

	Arabica	Robusta
• Date species described	1753	1895
• Chromosomes	44	22
• Time from flower to ripe cherry	9 months	10-11 months
• Yield (kg beans/ha)	1500-3000	2300-4000
• Root system	deep	shallow
• Optimum temperature	15-24°C	24-30°C
• Optimal rainfall	1.5-2.0 m	2.0-3.0 m
• Growth optimum	**1000-2000 m**	**0-700 m**
• Caffeine content of beans	**0.8-1.4%**	**1.7-4.0%**
• Shape of bean	flat	oval
• Typical brew characteristics	**acidity**	**bitterness**

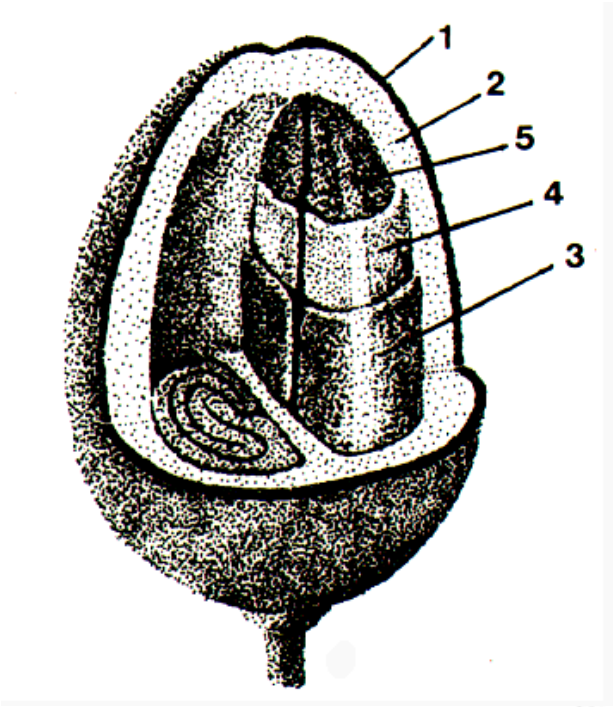
Traitement du café

Arabica

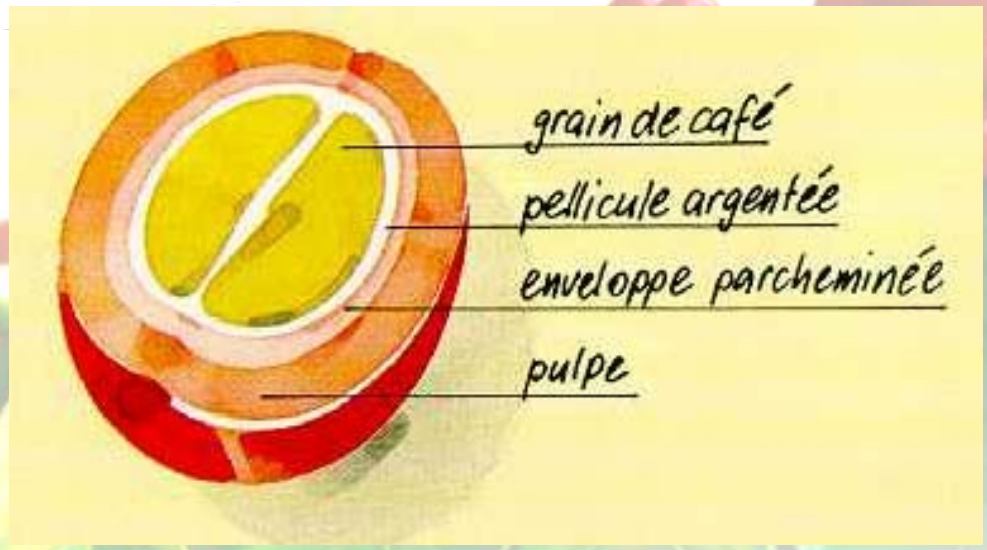
Robusta



La cerise du caféier



1. **Exocarpe** ou épiderme
2. **Mésocarpe** ou pulpe
3. **Endocarpe** ou parche
4. **Spermoderme** ou cuticule argenté
5. **Endosperme** ou graine



Coffee composition

Coffee composition

Compounds	Arabica green	Arabica roasted	Robusta green	Robusta roasted
	(% dry mat.)	(% dry mat.)	(% dry mat.)	(% dry mat.)
Caffeine	1.3	1.1	2.5	2
Trigonelline	1	0.5	0.7	0.3
Proteins	11	8	13	9
Free Amino Acids	0.4	0	0.6	0
Sucrose	8	0	5	0
Carbohydrates	56	38	50	40
Organic acids	2.5	3.5	1.5	3.5
Chlorogenic Acids	7	1.5	10	1
Lipids	14	16	10	11
Melanoidins		25.4		25.9
Ashes	4	4	4	4
Volatils	Traces	0.1	Traces	0.1
Water	9-12	2	10-13	2

Alteration of the chemistry and physiology of the bean

Cafés Malongo

Temperature
200-240°C

Time
4-20 min

ROASTING

Loss
free water
simple sugars
amino acids

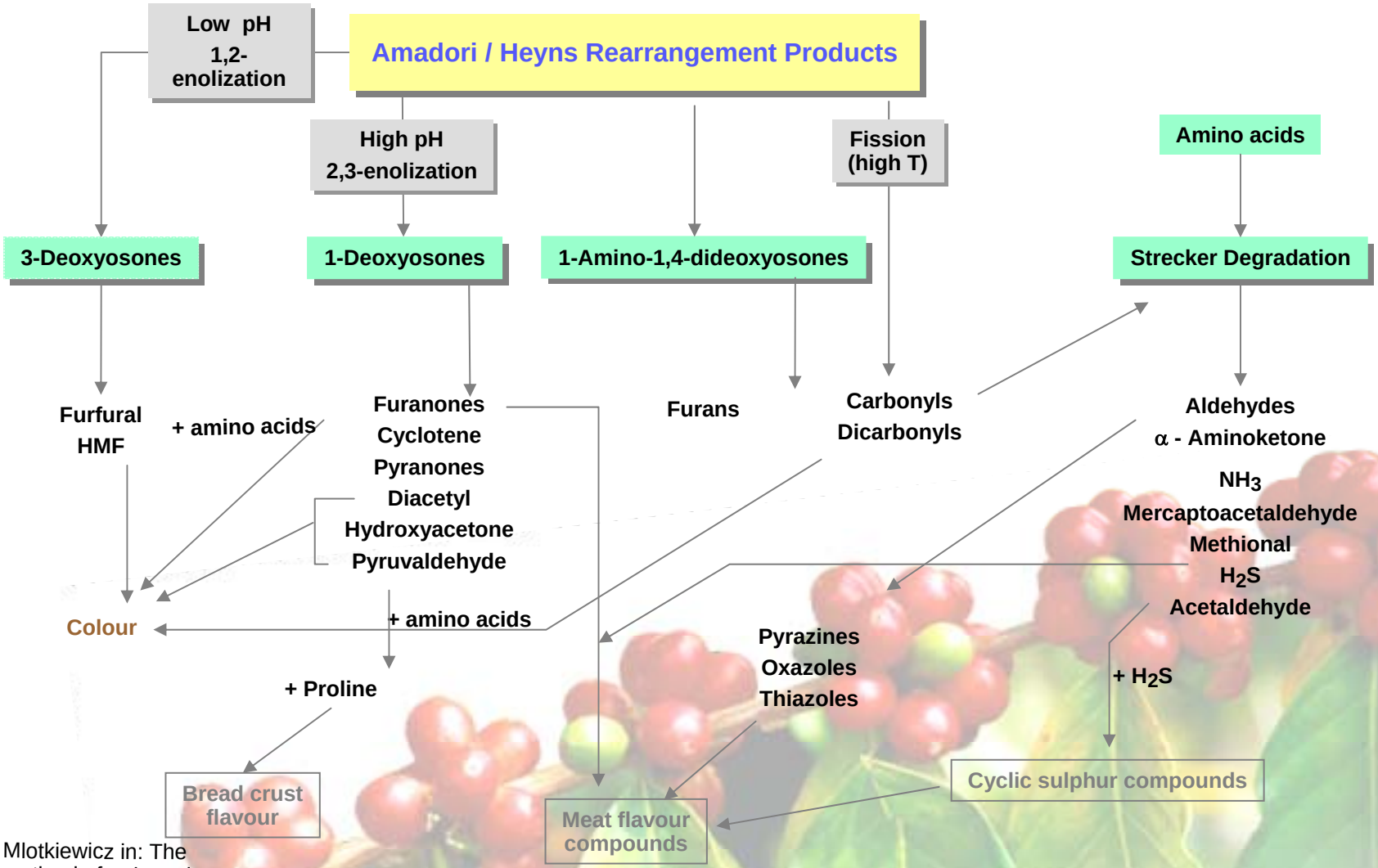
Decrease
proteins
chlorogenic acids
trigonelline

Expansion
50-100%

Aroma formation

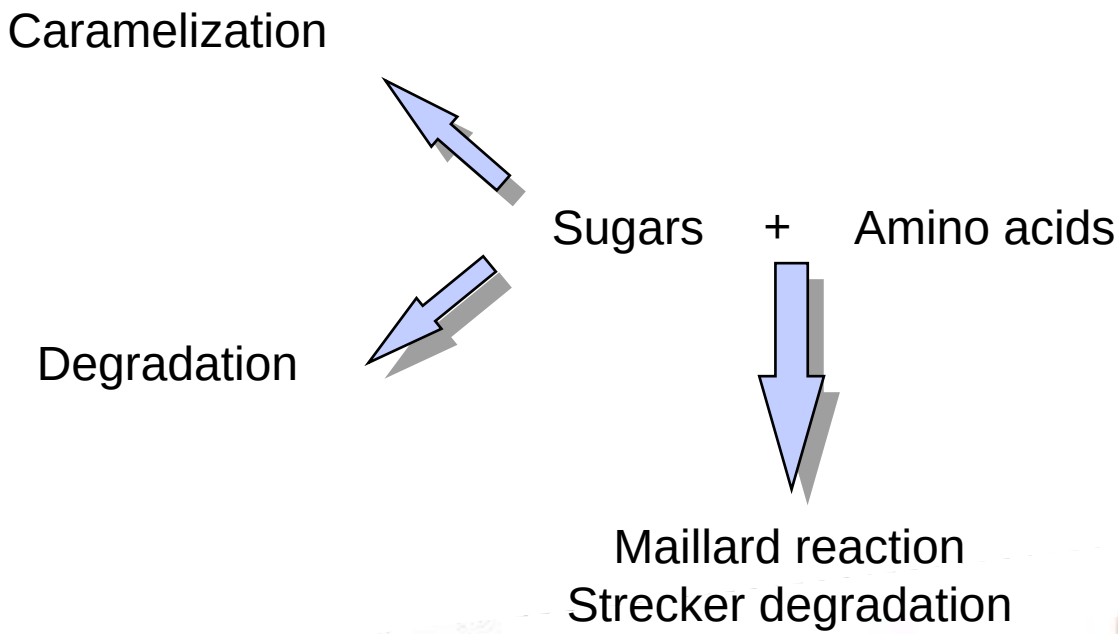
Browning
melanoidin formation

A current view of the Maillard reaction

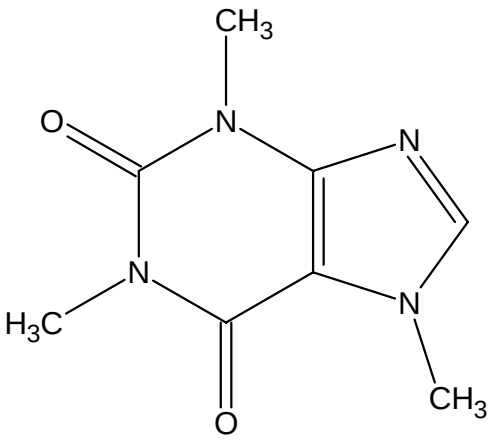


After J.A. Mlotkiewicz in: The Maillard reaction in foods and medicine, 1998

Reactivity between sugars and amino acids



Caffeine



Caffeine

W H O

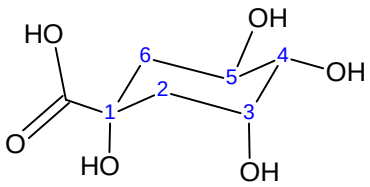
Addiction
1-Overpowering desire
2-Tendancy to increase dose
3-Psychic and physical dependance
4-Detrimental effect on the individual and society

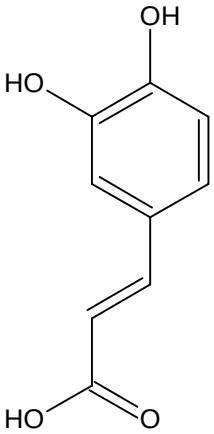
Drug habit
1-Strong but not compulsive desire
2-Moderate or no tendancy to increase dose
3-Psychic but no physiological abstinence
4-Detrimental effect on the individual

Nehlig,A..
ASIC 17th Colloque, Nairobi. **1997**, 35

CQA

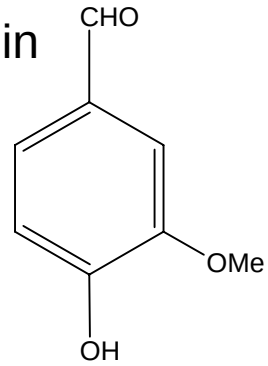
Caffeoylquinic acids

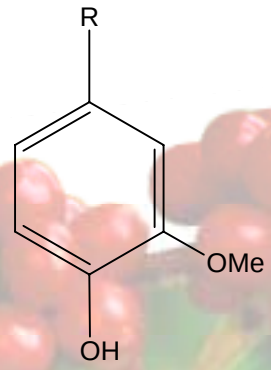




Roasting

Vanillin

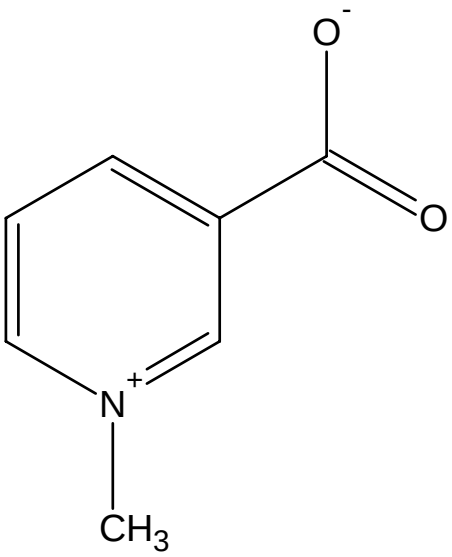




Guaiacols

3-CQA
4-CQA
5-CQA
3,5-di CQA
4,5-di CQA
3,4-di CQA

Trigonelline degradation



Trigonelline

Roasting

Pyridines 46%

Pyrroles 3%

Bicyclic compounds 29%

Miscellaneous 22%

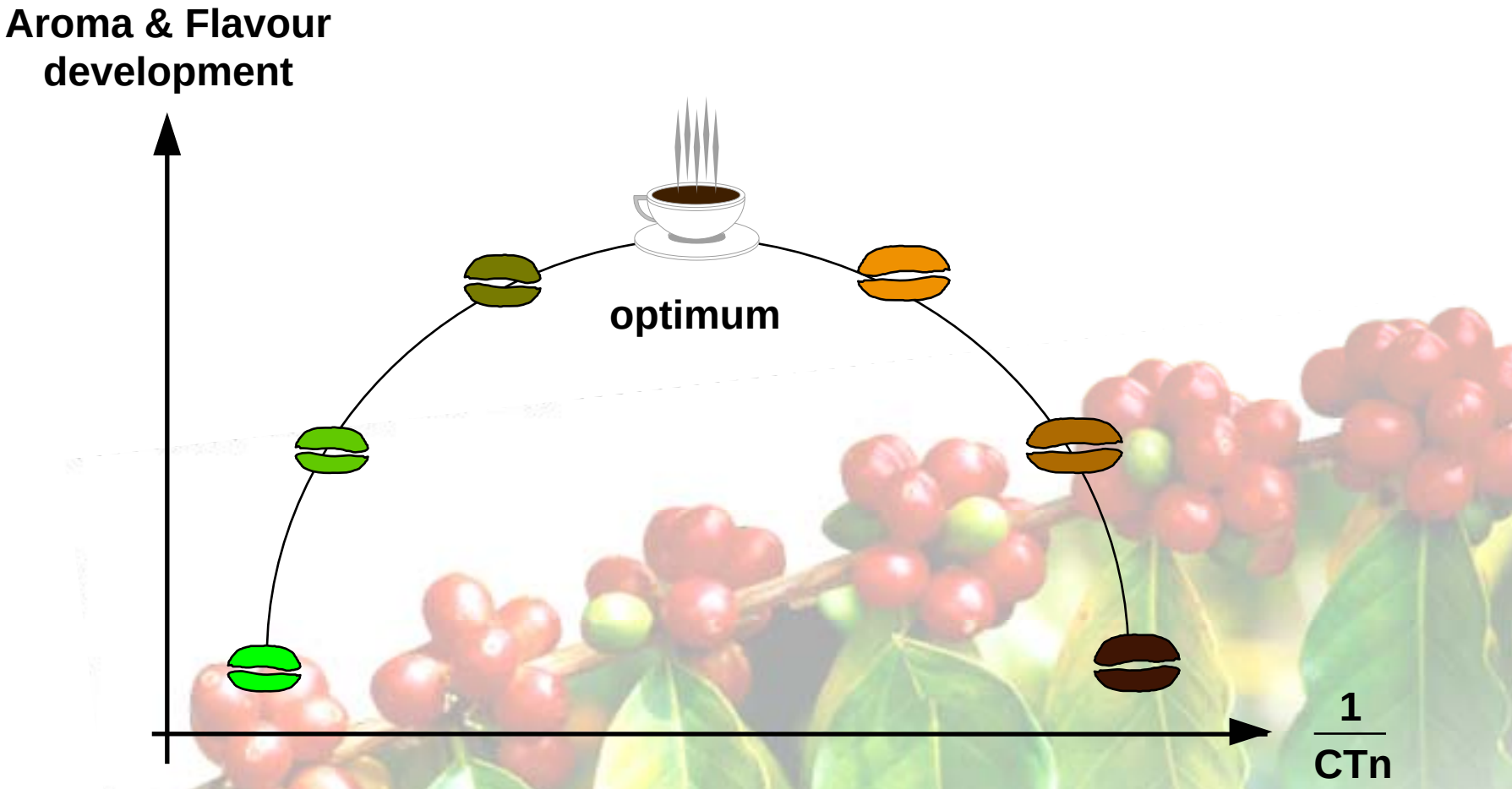
Viani,R.; Horman,I.
J. Food Sci. **1974**, 39(6), 1216

Coffee amino acids

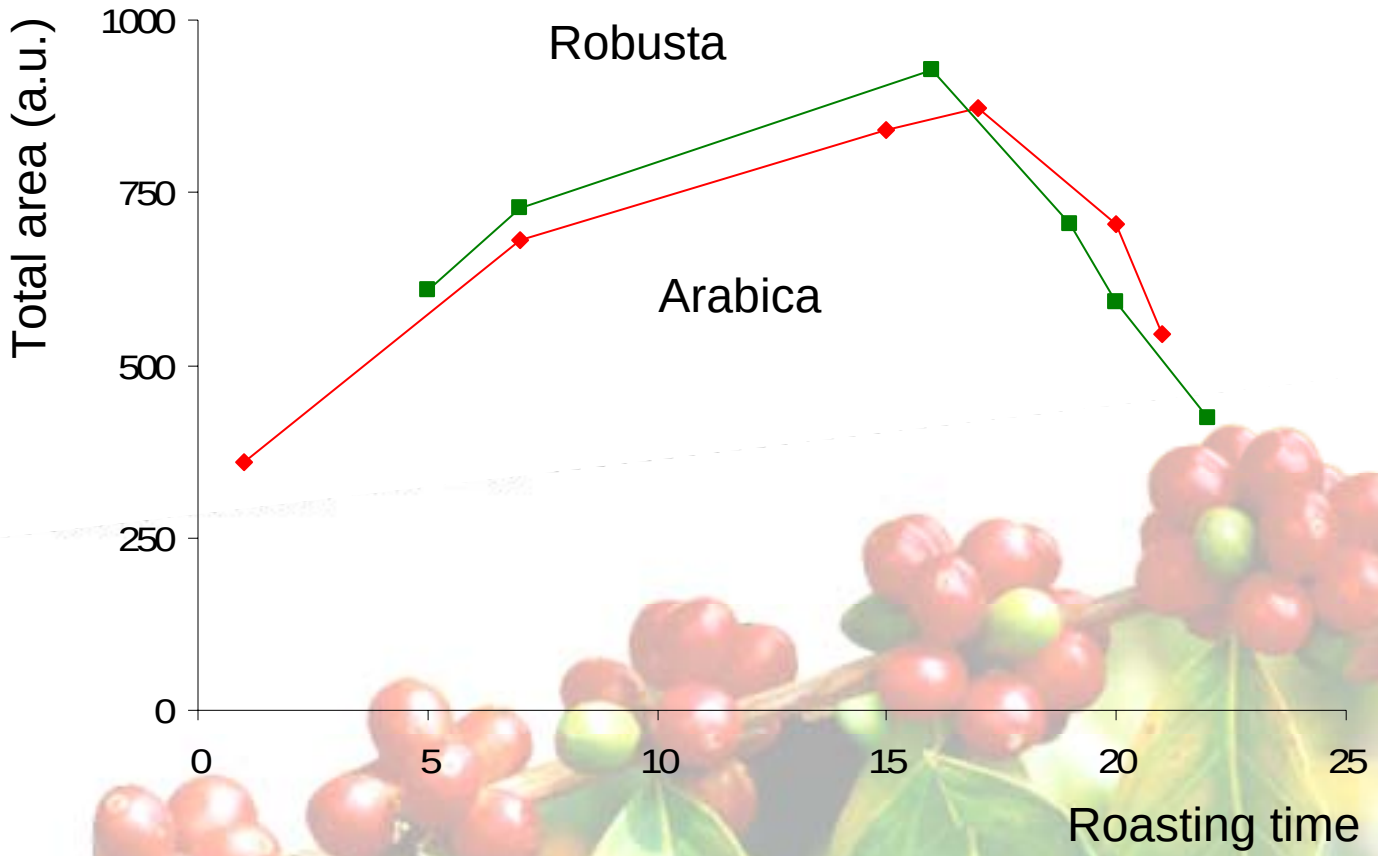
Free amino acids	g amino acids / 100 gram dry beans
Glutamic acid	0.135
Aspartic acid	0.051
Asparagine	0.052
Alanine	0.055
γ-Aminobutyric acid	0.047
Serine	0.032
Proline	0.034
Phenylalanine	0.017
Tryptophan	0.015
Leucine	0.010
Arginine	0.008
Tyrosine	0.006
Lysine	0.005
Glycine	0.008
Valine	0.007
Isoleucine	0.007
Threonine	0.005
Histidine	0.004
Total	**0.497**

Degree of roast is measured by CTn

- Colour Test number



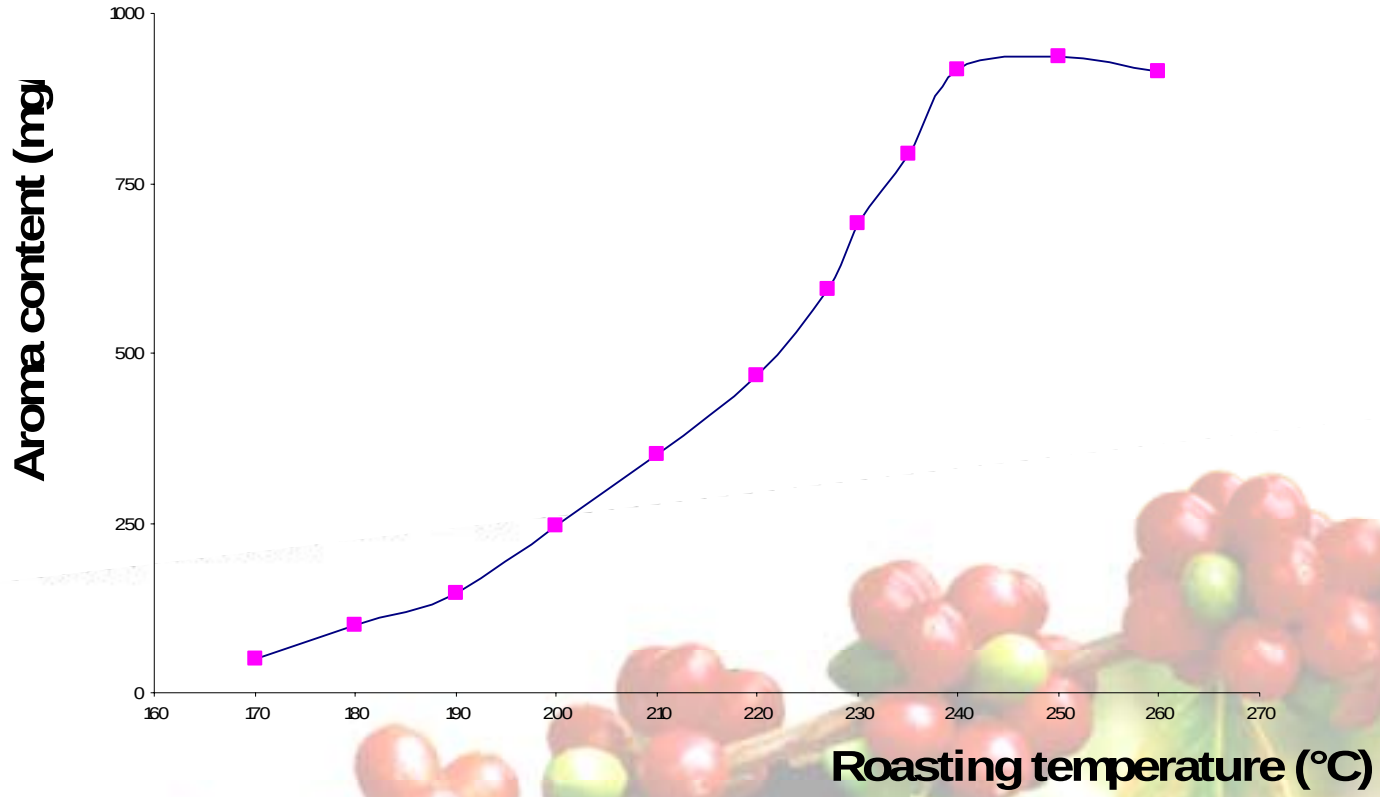
Total volatil content = f (roasting degree)



Holscher, W.; Steinhart, H.
Z. Lebensm. -Unters. Forsch. **1992**, 195, 33-38

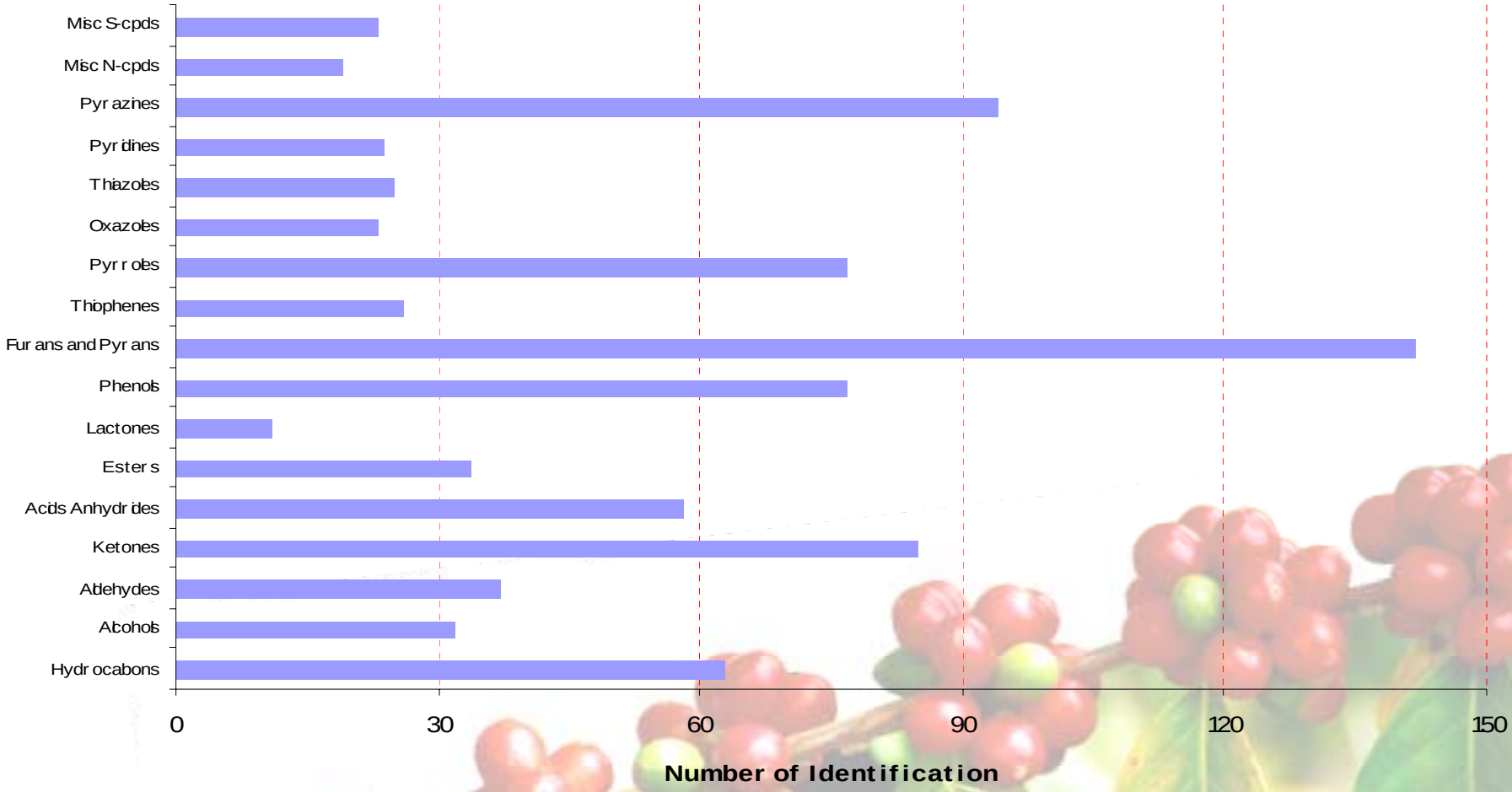
Coffee aroma evolution = f (T)

Roasting time= 5 min



Silwar, R.; Lüllmann, C.
Café Cacao Thé **1993,** *37* (2), 145

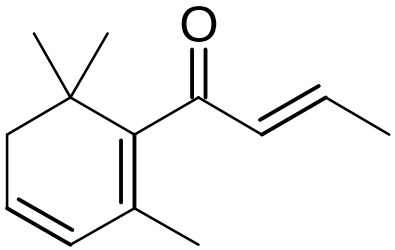
Volatile constituents of Coffee



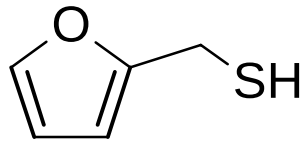
Flament, I.et al.
Coffee Flavor Chemistry **2002**

Flament, Gautschi, Winter, Willhalm, Stoll, Goldman, Seibl
1967…

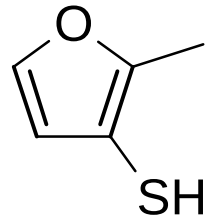
Main coffee odourants



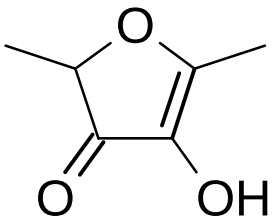
β-Damascenone
1-10 ppt



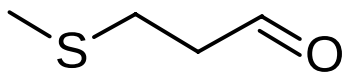
2-Furanmethanethiol
5-40 ppt



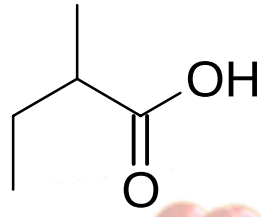
3-Furanthiol, 2-methyl
5-10 ppt



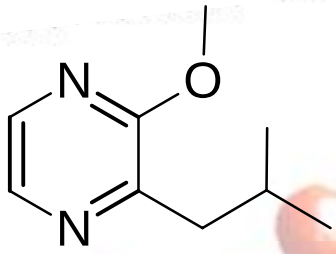
Furaneol
003-1 ppb



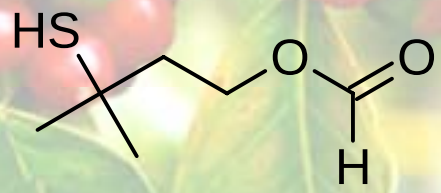
Methional
0.4-0.1 ppb



Butanoic acid, 2-methyl
100 ppb



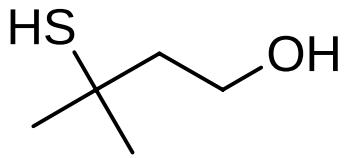
Pyrazine, 2-isobutyl 3-methoxy
2 ppt



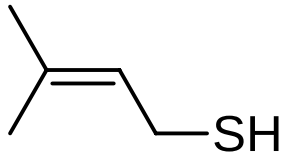
3-Mercapto 3-methylbutyl formate
2-5 ppt

Holscher, W..et al.
Café Cacao Thé **1990**, 34, 205

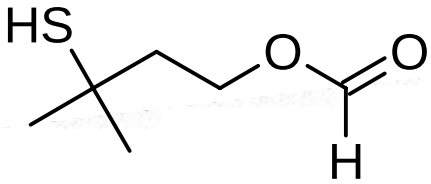
Sulfur compounds



3-Mercapto 3-methyl butanol
2-6 ppt



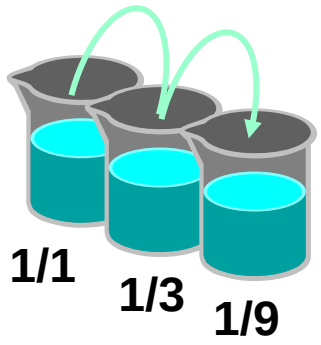
3-Methyl 2-buten-1-thiol
0.2-04 ppt



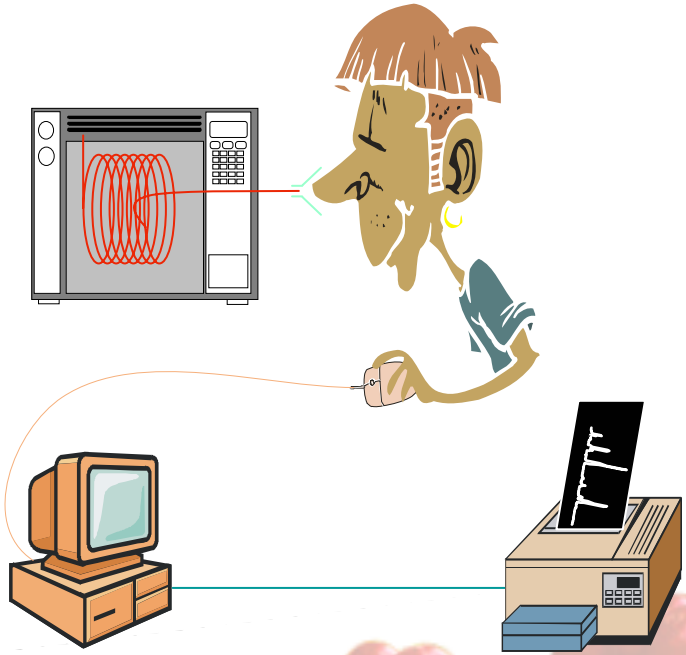
3-Methyl 3-mercaptobutyl formate
2-5 ppt

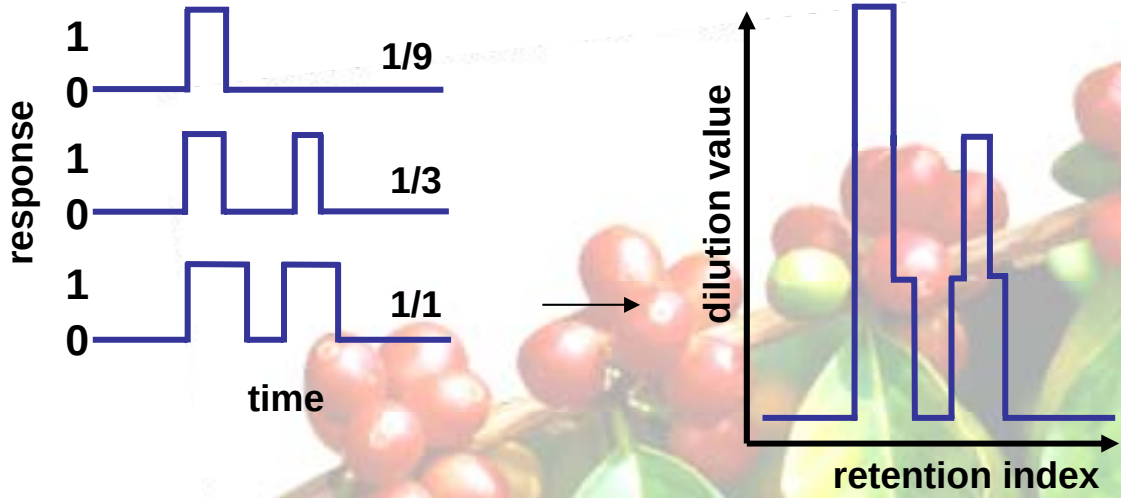
Holscher, W.; Steinhart, H.
ASIC 14 Colloque **1991**, 130

GC-Sniffing methodology



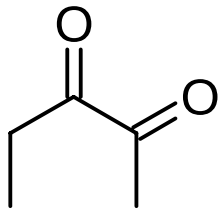
Serial Dilution



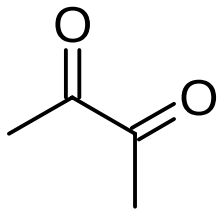


Acree, T.E. **1993**

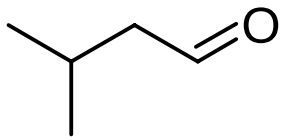
Main coffee odourants and odour thresholds



Pentanedione
20-30 ppb

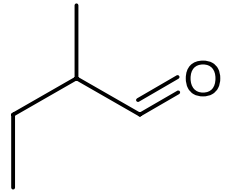


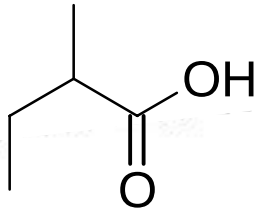
Butanedione
1-5 ppb



Butanal, 3-methyl
1-10 ppb

Butanal, 2-methyl
1-10 ppb

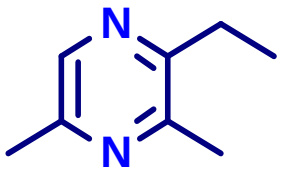




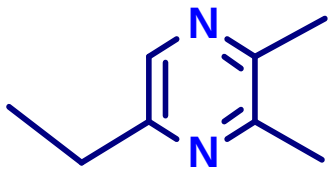
Butanoic acid, 2-methyl
100 ppb

Odour thresholds (ng/l air)

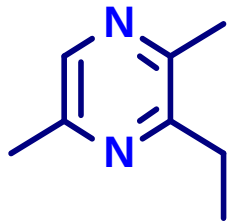
Pyrazine, ethyl dimethyl isomers



2-ethyl 3,5-dimethyl
0.011



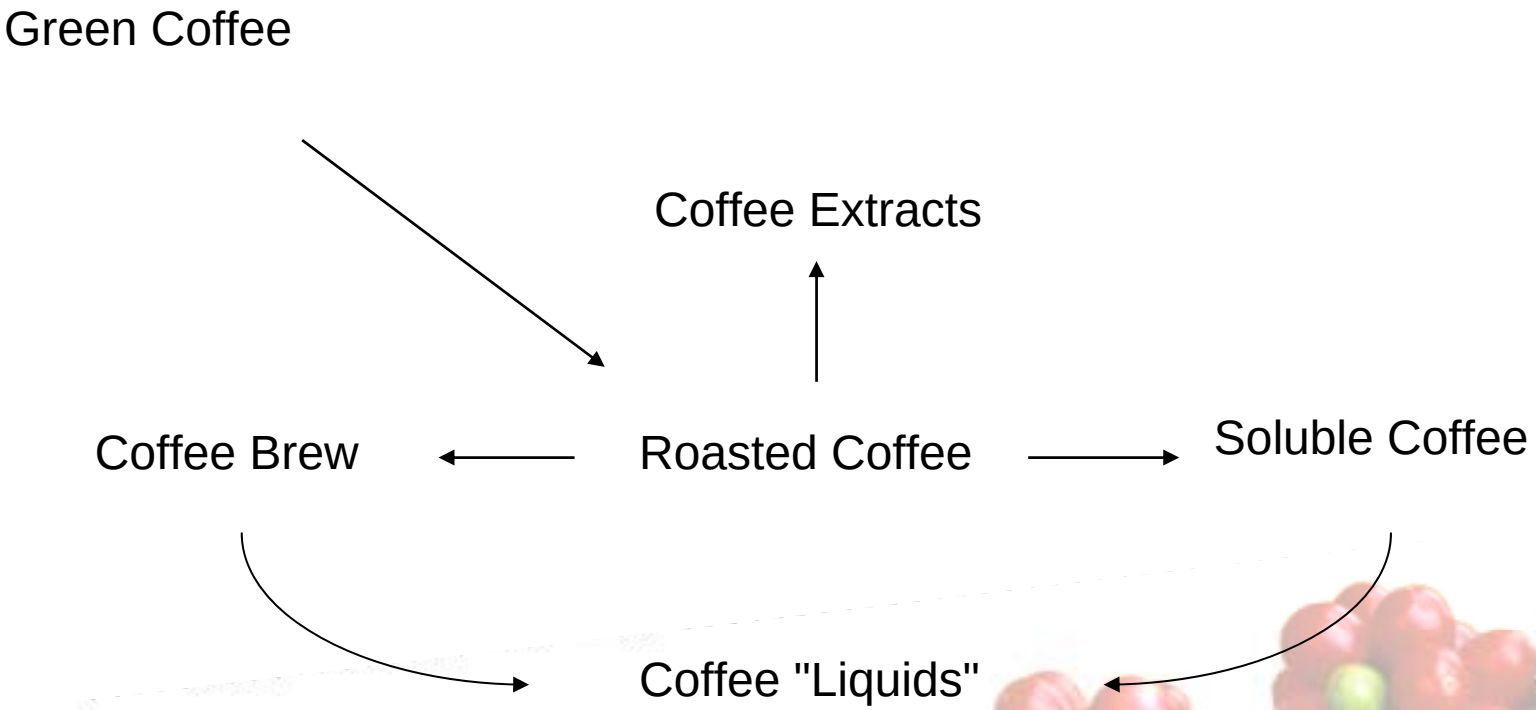
5-ethyl 2,3-dimethyl
200



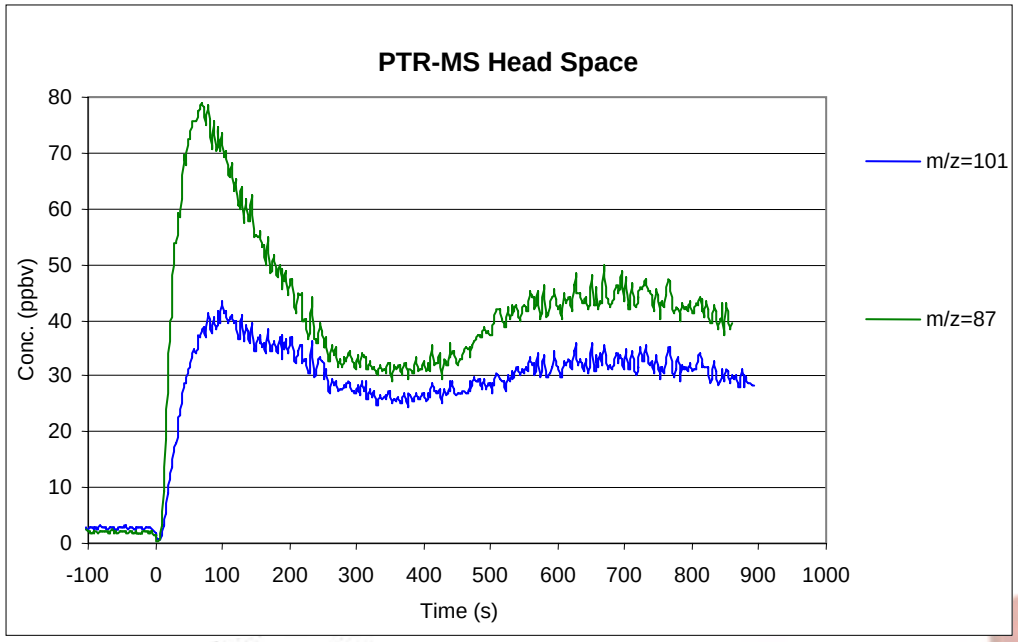
3-ethyl 2,5-dimethyl
3.6

Wagner, R. et al
Z. Lebensm. -Unters. Forsch. 1999, 208, 308

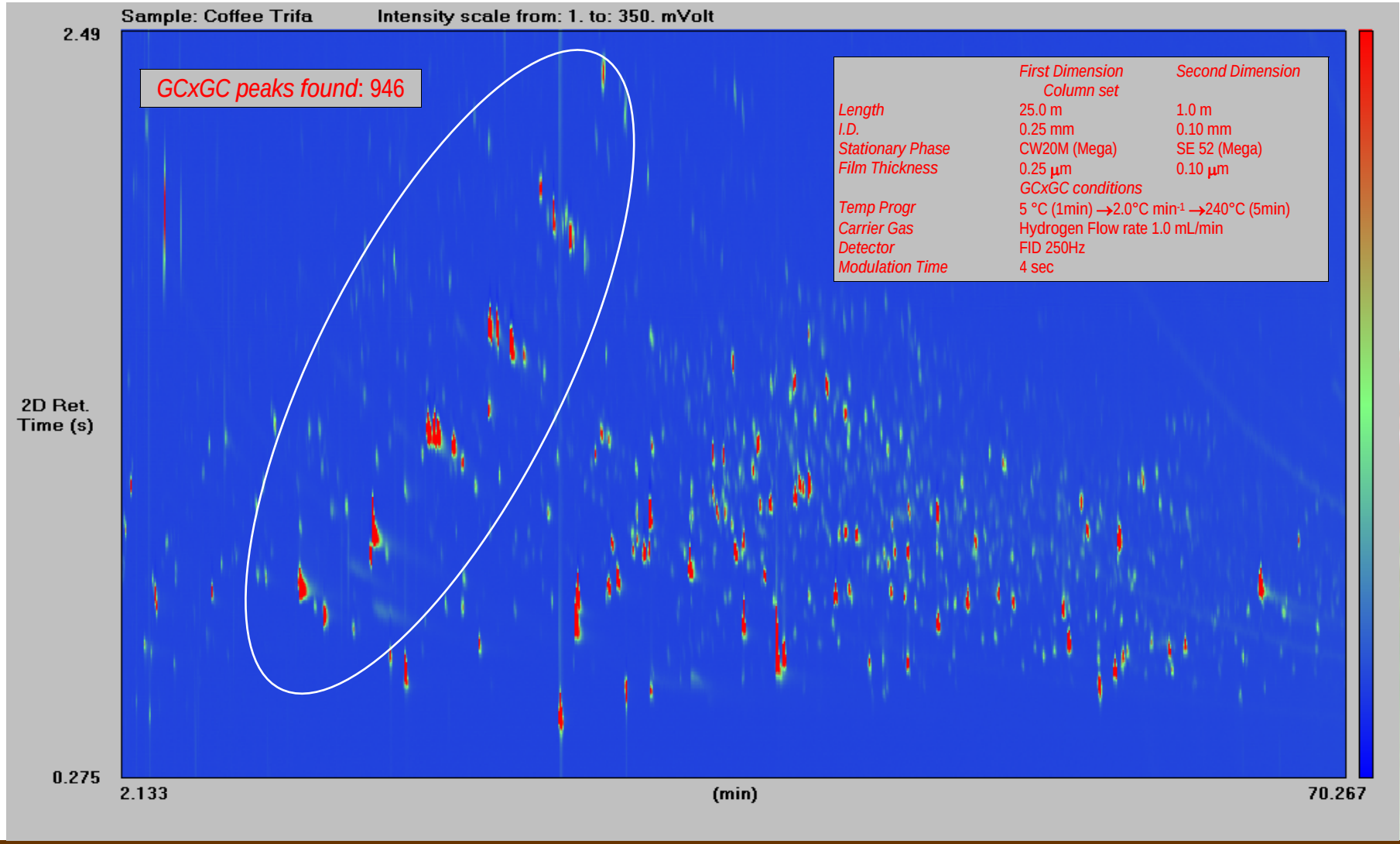
Coffee flavour: analytical investigations



HS during comsumption

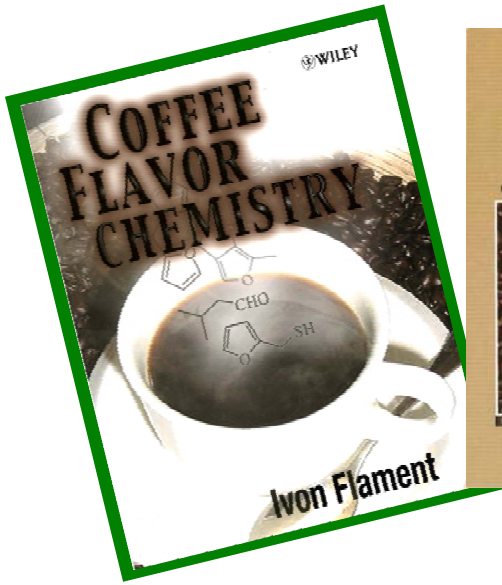


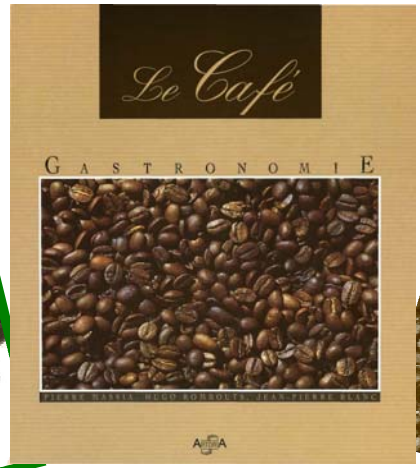
GCxGC profiles of roasted coffee

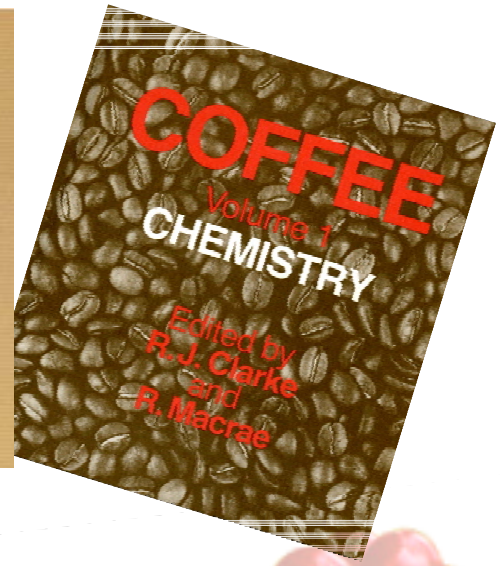


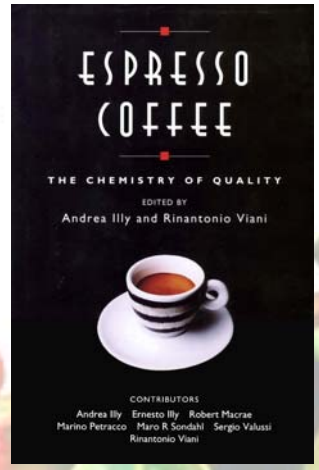
GCxGC profile of roasted coffee

References

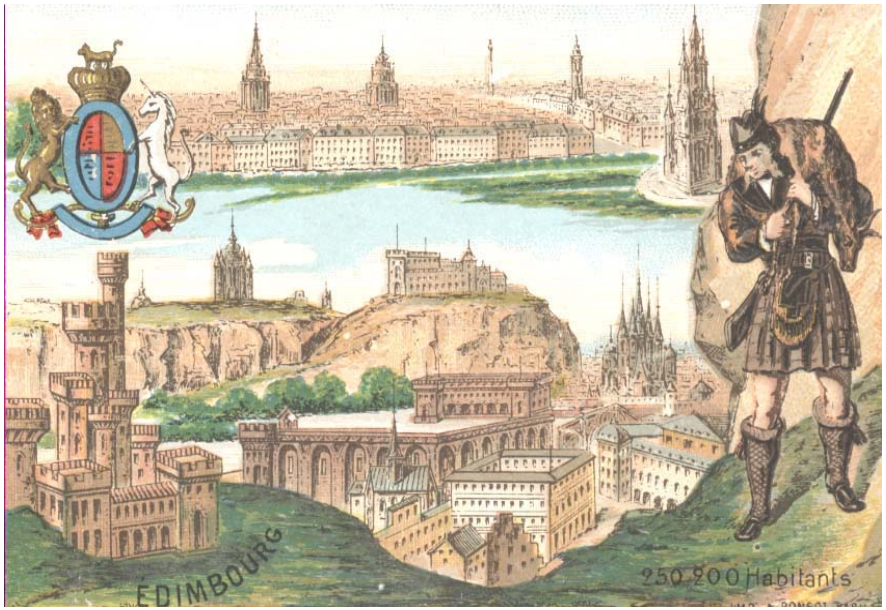

WILEY
COFFEE FLAVOR CHEMISTRY
Ivon Flament

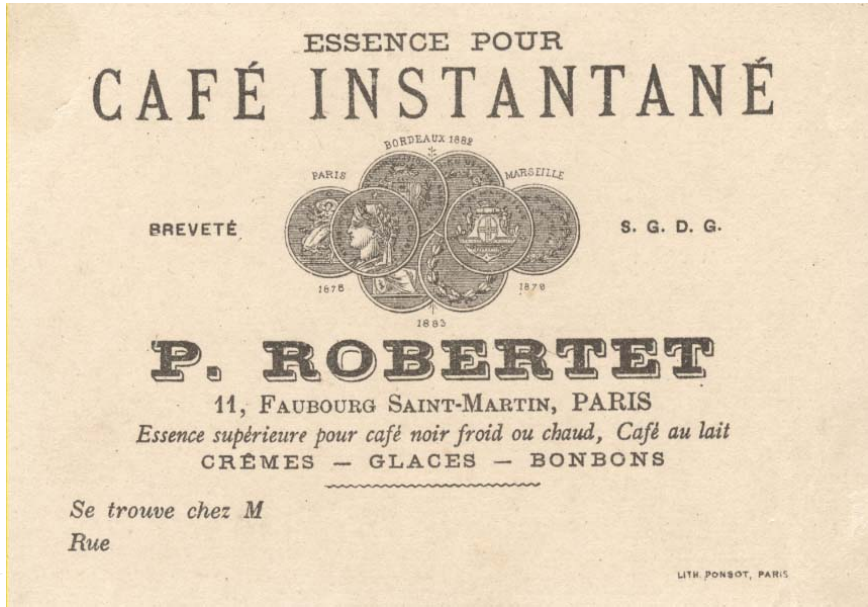

Le Café
GASTRONOMIE


COFFEE
Volume 1
CHEMISTRY
Edited by
R.J. Clarke
and
R. Macrae

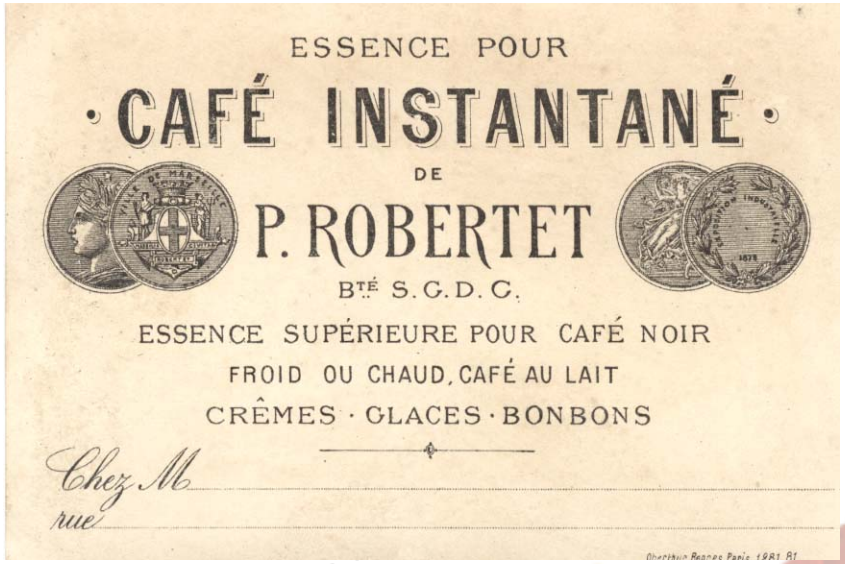

ESPRESSO COFFEE
THE CHEMISTRY OF QUALITY
EDITED BY
Andrea Illy and Rinantonio Viani
CONTRIBUTORS
Andrea Illy Ernesto Illy Robert Macrae
Marino Petracco Maro R Sondahl Sergio Valussi
Rinantonio Viani

Robertet and coffee





Robertet and coffee



LA SEMEUSE
LE CAFÉ QUE L'ON SAVOURE

Automate-La Semeuse
M-A Bloch