Titles in the IFT Press series

- Accelerating New Food Product Design and Development (Jacqueline H. Beckley, Elizabeth J. Topp, M. Michele Foley, J.C. Huang, and Witoon Prinyawiwatkul)
- Advances in Dairy Ingredients (Geoffrey W. Smithers and Mary Ann Augustin)
- Bioactive Proteins and Peptides as Functional Foods and Nutraceuticals (Yoshinori Mine, Eunice Li-Chan, and Bo Jiang)
- Biofilms in the Food Environment (Hans P. Blaschek, Hua H. Wang, and Meredith E. Agle)
- Calorimetry in Food Processing: Analysis and Design of Food Systems (Gönül Kaletunc)
- Coffee: Emerging Health Effects and Disease Prevention (YiFang Chu)
- Food Carbohydrate Chemistry (Ronald E. Wrolstad)
- Food Irradiation Research and Technology (Christopher H. Sommers and Xuetong Fan)
- High Pressure Processing of Foods (Christopher J. Doona and Florence E. Feeherry)
- Hydrocolloids in Food Processing (Thomas R. Laaman)
- Improving Import Food Safety (Wayne C. Ellefson, Lorna Zach, and Darryl Sullivan)
- Innovative Food Processing Technologies: Advances in Multiphysics Simulation (Kai Knoerzer, Pablo Juliano, Peter Roupas, and Cornelis Versteeg)
- Microbial Safety of Fresh Produce (Xuetong Fan, Brendan A. Niemira, Christopher J. Doona, Florence E. Feeherry, and Robert B. Gravan)
- Microbiology and Technology of Fermented Foods (Robert W. Hutkins)
- Multivariate and Probabilistic Analyses of Sensory Science Problems (Jean-François Meullenet, Rui Xiong, and Christopher J. Findlay)
- Natural Food Flavors and Colorants (Mathew Attokaran)
- Nondestructive Testing of Food Quality (Joseph Irudayaraj and Christoph Reh)
- Nondigestible Carbohydrates and Digestive Health (Teresa M. Paeschke and William R. Aimutis)
- Nonthermal Processing Technologies for Food (Howard Q. Zhang, Gustavo V. Barbosa-Cánovas, V.M. Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, and James T.C. Yuan)
- Nutraceuticals, Glycemic Health and Type 2 Diabetes (Vijai K. Pasupuleti and James W. Anderson)
- Organic Meat Production and Processing (Steven C. Ricke, Michael G. Johnson, and Corliss A. O’Bryan)
- Packaging for Nonthermal Processing of Food (Jung H. Han)
- Preharvest and Postharvest Food Safety: Contemporary Issues and Future Directions (Ross C. Beier, Suresh D. Pillai, and Timothy D. Phillips, Editors; Richard L. Ziprin, Associate Editor)
- Regulation of Functional Foods and Nutraceuticals: A Global Perspective (Clare M. Hasler)
- Sensory and Consumer Research in Food Product Design and Development, second edition (Howard R. Moskowitz, Jacqueline H. Beckley, and Anna V.A. Resurreccion)
- Sustainability in the Food Industry (Cheryl J. Baldwin)
- Thermal Processing of Foods: Control and Automation (K.P. Sandeep)
- Water Activity in Foods: Fundamentals and Applications (Gustavo V. Barbosa-Cánovas, Anthony J. Fontana Jr., Shelly J. Schmidt, and Theodore P. Labuza)
- Whey Processing, Functionality and Health Benefits (Charles I. Onwulata and Peter J. Huth)
2 Coffee Constituents 21
Adriana Farah

2.1 Introduction 21

2.2 Production of coffee and coffee-based beverages 22
2.2.1 Green coffee production 22
2.2.2 Decaffeinated coffee production 23
2.2.3 Steam-treated and monsooned coffees 24
2.2.4 Coffee roasting 24
2.2.5 Coffee brewing 25
2.2.6 Instant coffee production 26

2.3 Natural coffee constituents 26
2.3.1 Green coffee chemical composition 27
2.3.1.1 Nonvolatile compounds in green coffee 27
   Caffeine 28
   Trigonelline 29
   Chlorogenic acids 30
   Cafestol and kahweol 31
   Soluble dietary fiber 32
   Water 33
   Carbohydrates 33
   Protein, peptides, and free amino acids 33
   Minerals 33
   Lipids 34

2.3.1.2 Volatile compounds in green coffee 34

2.3.2 Changes in coffee chemical composition during roasting 35
2.3.2.1 Nonvolatile components in roasted coffee 35
2.3.2.2 Volatile compounds in roasted coffee 37

2.3.3 Changes in coffee chemical composition during special coffee processing 39

2.3.4 Chemical composition of coffee brew 41

2.4 Incidental coffee constituents 43
2.4.1 Incidental nonvolatile compounds in coffee 43
2.4.1.1 Ochratoxin A 43
2.4.1.2 Biogenic amines 44
2.4.1.3 β-carbolines 45
2.4.1.4 Acrylamide 46
2.4.1.5 Polycyclic aromatic hydrocarbons 47
2.4.1.6 Pesticide residues 48

2.4.2 Incidental volatile constituents in coffee 48

2.5 Concluding remarks 50
Acknowledgments 50
References 50
3 Bioavailability of Coffee Chlorogenic Acids
Angélique Stalmach

3.1 Introduction 59

3.2 Chlorogenic acids: contribution of coffee to dietary levels ingested 59
  3.2.1 Dietary intake 59
  3.2.2 Levels in coffee beverage 61

3.3 Bioavailability of coffee chlorogenic acids 62
  3.3.1 Absorption and metabolic fate 62
  3.3.2 Extensive metabolism upon intake 62
    3.3.2.1 Identification of chlorogenic acid metabolites 62
    3.3.2.2 Metabolic pathways 62
    3.3.2.3 Bioavailability of intact chlorogenic acids 68
  3.3.3 Urinary and biliary excretion 71
  3.3.4 Effects of food matrix and co-ingestion on bioavailability 71

3.4 Conclusions 72

References 73

4 Coffee and Alzheimer’s Disease: Animal and Cellular Evidence
Marshall G. Miller and Barbara Shukitt-Hale

4.1 Introduction 77

4.2 Alzheimer’s disease 77
  4.2.1 Prevalence 77
  4.2.2 Symptoms 78
  4.2.3 Gross pathology 78
  4.2.4 Tauopathy 78
  4.2.5 Cerebral amyloidosis 78
  4.2.6 Other neuropathology 79
  4.2.7 Genetic factors 79
  4.2.8 Diagnosis 80
  4.2.9 Treatments 80
  4.2.10 Cellular and animal models of Alzheimer’s disease 80

4.3 Coffee 81
  4.3.1 Cellular evidence 81
  4.3.2 Animal evidence 82

4.4 Caffeine 82
  4.4.1 Cellular evidence 83
  4.4.2 Animal evidence 83

4.5 Phenolics 86
  4.5.1 Cellular evidence 86
  4.5.2 Animal evidence 87
  4.5.3 Caffeic acid 88
  4.5.4 Dichromanolquinides 89

4.6 Other coffee constituents 89
  4.6.1 Trigonelline 89
  4.6.2 Kahweol and cafestol 90
  4.6.3 Pyroglutamate 91
Contents

4.7 Conclusions 91
References 92

5 Coffee and Alzheimer’s Disease—Epidemiologic Evidence 97
Joan Lindsay, Pierre-Hugues Carmichael, Edeltraut Kröger, and Danielle Laurin
5.1 Introduction 97
5.2 Review of epidemiologic studies of coffee in relation to Alzheimer’s disease, dementia, and selected aspects of cognitive functioning 98
5.2.1 Case-control/retrospective studies 98
5.2.2 Cross-sectional studies 99
5.2.3 Prospective cohort studies 100
5.3 The strength of the evidence for preventing Alzheimer’s disease 106
References 108

6 Coffee and Parkinson’s Disease 111
Jing-Wei Lim and Eng-King Tan
6.1 Introduction 111
6.2 Pathogenesis of Parkinson’s disease 111
6.3 Gene and environmental/lifestyle factors 112
6.4 Clinical evidence linking coffee consumption and Parkinson’s disease 113
6.5 Neuroprotection and active components of coffee 115
6.6 Adenosine receptor antagonism and Parkinson’s disease 116
6.7 Caffeine rescue of Parkinson’s disease in animal models 116
6.8 Clinical trials of adenosine receptor antagonists in Parkinson’s disease 117
6.9 Caffeine-mediated genetic susceptibility of Parkinson’s disease 118
6.10 Summary 118
Acknowledgments 119
References 119

7 Coffee and Liver Health 123
Pablo Muriel and Jonathan Arauz
7.1 The liver 123
7.2 Epidemiologic studies 124
7.2.1 Coffee and liver enzymes 124
7.3 Coffee, fibrosis, and cirrhosis 124
7.3.1 General aspects of fibrosis and cirrhosis 124
7.3.2 Coffee and cirrhosis 125
7.4 Coffee and animal models of hepatic fibrosis 126
7.5 Cytokines and liver fibrosis 127
7.5.1 Transforming growth factor-β in liver fibrogenesis 128
7.6 Mechanism of coffee’s protective effect 128
7.6.1 Oxidative stress, antioxidant-dependent mechanisms 128
7.6.2 Chemoprotective mechanisms: cafestol and kahweol 130
7.6.3 Phase I-mediated mechanisms 130
7.6.4 Inhibition of phase I activating enzyme expression 130
7.6.5 Inhibition of phase I enzymatic activity 131
8 Coffee and Type 2 Diabetes Risk
Nathan V. Matusheski, Siamak Bidel, and Jaakko Tuomilehto

8.1 Introduction 141
8.2 Observational associations between coffee consumption and type 2 diabetes risk 142
8.3 Coffee preparation 154
8.3.1 Type of coffee: ground or instant 154
8.3.2 Addition of milk or sugar 155
8.3.3 Caffeine and noncaffeine components of coffee 155
8.3.4 Lifestyle-related factors 156
8.4 Observational associations between coffee consumption and diabetes risk factors 156
8.5 Intervention studies in human subjects 159
8.5.1 Effects of caffeine on glucose tolerance 159
8.5.2 Effects of caffeinated coffee on glucose tolerance 160
8.5.3 Effects of noncaffeine coffee components on glucose tolerance 164
8.5.4 Effects of coffee consumption on other diabetes risk factors 165
8.5.5 Limitations of the existing intervention literature on coffee and diabetes 165
8.6 Possible mechanisms of action 166
8.6.1 Modulation of energy expenditure by caffeine 167
8.6.2 Modulation of carbohydrate absorption and incretin response 167
8.6.3 Modulation of hepatic glucose output 167
8.6.4 Modulation of insulin sensitivity 168
8.6.4.1 Anti-inflammatory effects 168
8.6.4.2 Antioxidative effects 169
8.6.4.3 Estrogen receptor activation 169
8.6.4.4 Inhibition of 11β-hydroxysteroid dehydrogenase 169
8.6.4.5 Iron and magnesium status 170
8.7 Summary and conclusions 170
References 171

9 Coffee and Cardiovascular Diseases
Siamak Bidel and Jaakko Tuomilehto

9.1 Introduction 181
9.2 Coffee components and CVD 181
9.2.1 Caffeine 182
9.2.2 Diterpenes: kahweol & cafestol 182
9.2.3 Polyphenols 183
Contents

9.3 Early, transient, or acute effects of coffee consumption on CVD 183
  9.3.1 Tolerance or modification 184
9.4 Coffee metabolism and CVD: genetic influences 185
9.5 Long-term habitual coffee consumption and CVD 185
  9.5.1 Coffee and CHD 185
    9.5.1.1 Coffee consumption, blood pressure, and hypertension 186
    9.5.1.2 Coffee intake and risk of type 2 diabetes 187
    9.5.1.3 Coffee and atherosclerosis 188
    9.5.1.4 Coffee consumption and plasma homocysteine 188
9.6 Coffee consumption and heart failure 189
9.7 Coffee consumption and stroke 189
9.8 Summary 190
References 190

10 Coffee and Cancers 197
André Nkondjock
  10.1 Introduction 197
  10.2 Breast cancer 198
  10.3 Colorectal cancer 198
  10.4 Prostate cancer 199
  10.5 Bladder cancer 199
  10.6 Gastric cancer 200
  10.7 Ovarian cancer 201
  10.8 Pancreatic cancer 201
  10.9 Liver cancer 201
  10.10 Head and neck cancers 202
  10.11 Endometrial cancer 203
  10.12 Kidney cancer 204
  10.13 Brain cancer 204
  10.14 Cancer survival 204
  10.15 Conclusions 205
References 205

11 Coffee Consumption and Mortality Risk 211
Kemmyo Sugiyama, Shinichi Kuriyama, and Ichiro Tsuji
  11.1 Introduction 211
  11.2 Coffee consumption and all-cause mortality 211
  11.3 Coffee consumption and CVD mortality 221
  11.4 Coffee consumption and cancer mortality 222
  11.5 Possible mechanism of CVD mortality reduction by coffee 223
  11.6 Conclusions 223
References 224

12 Is Coffee the Next Red Wine? Coffee Polyphenol and Cholesterol Efflux 227
Harumi Kondo, Makoto Ayaori, and Katsunori Ikewaki
  12.1 High-density lipoprotein and cardiovascular disease 227

For more Ebooks, Please email me at universityonlinebookstore@gmail.com
## Contents

12.2 Coffee and cardiovascular disease 227
12.3 Coffee polyphenols 228
12.4 Coffee polyphenols and cholesterol efflux 229
References 230

13 **Additional Positive Impacts on Health**
Yi-Fang Chu and Yumin Chen

13.1 Coffee intake and reduced risk of suicide 233
13.2 Enhanced cognitive performance and mood 235
13.3 Coffee bioactive compounds 236
References 238

14 **Epidemiological Evidence for Maternal Prenatal Coffee and Caffeine Consumption and Miscarriage Risk**
Ronna L. Chan

14.1 Introduction 243
14.2 Coffee consumption during pregnancy: a three-decade-old concern 243
14.3 Evidence from the current literature 244
14.4 Methodological concerns and limitations for studies on coffee or caffeine exposure and miscarriage 247
14.4.1 Study design and subject recruitment 247
14.4.2 Exposure assessments 247
14.4.2.1 Quantifying individual caffeine exposure 247
14.4.2.2 Accounting for other sources of caffeine 249
14.4.2.3 Identifying critical timing of exposures 249
14.4.2.4 Maternal, fetal, and placental caffeine metabolism 250
14.4.2.5 Use of self-reporting versus biomarker data 251
14.4.3 Analytical approach: controlling for key confounders 251
14.4.3.1 Confounding by nausea and vomiting in pregnancy 251
14.4.3.2 Confounding by cigarette smoking 252
14.4.4 Determining gestational age, late recognition of fetal demise, and pregnancy outcome assessment 252
14.5 Risk for recurrent miscarriage 253
14.6 Conclusion, public health implications, and recommendations for future studies 254
References 255

15 **Acrylamide in Coffee**
Richard H. Stadler and Viviane Theurillat

15.1 Introduction 259
15.2 Methods of analysis 260
15.3 Occurrence in coffee and exposure estimates 260
15.4 Mechanisms of formation 262
15.5 Mitigation options 264
15.5.1 Agronomical stage (green bean) 264

---

For more Ebooks, Please email me at universityonlinebookstore@gmail.com
15.5.2 Processing conditions
15.5.2.1 Roasting
15.5.2.2 Asparaginase
15.5.2.3 Others (e.g., lactic acid bacteria)
15.5.3 Final preparation (brew strength)
15.5.4 Storage and shelf-life stability
15.6 Risk assessment and risk management
15.7 Conclusions

References

16 Impact of Coffee on Gastric Acid Secretion
Malte J. Rubach and Veronika Somoza

16.1 Introduction
16.2 Regulation of gastric acid secretion
16.2.1 Phases of gastric secretion
16.2.2 Gastric H,K-ATPase
16.3 Effects of coffee on gastric secretion
16.3.1 Effects of decaffeinated coffee vs. regular coffee
16.3.2 Effects of steam-treated and dewaxed coffee
16.3.3 Ulcerogenic effects of coffee beverages and their chemopreventive potential
16.3.4 Recent approaches to evaluate the gastric irritation potential of coffee beverages
16.4 Optimization of coffee bean processing to reduce the gastric acid stimulatory potential of coffee
16.4.1 Extraction
16.4.2 Dewaxing
16.4.3 Roasting
16.5 Dietary impact on the gastric acid stimulatory potential of coffee
16.6 Conclusions

References

17 Potential Mental Risks
Emma Childs and Harriet de Wit

17.1 Epidemiology of coffee and other forms of caffeine
17.2 Beneficial effects of caffeine
17.3 Risks associated with caffeine use
17.3.1 Acute intoxication
17.3.2 Tolerance and physical dependence
17.3.3 Anxiety
17.3.4 Sleep disorders
17.3.5 Psychosis
17.3.6 Other
17.4 Summary and conclusions

References
## 18 Furan in Coffee

Helmut Guenther

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1</td>
<td>Introduction</td>
<td>307</td>
</tr>
<tr>
<td>18.2</td>
<td>Physical and chemical properties</td>
<td>307</td>
</tr>
<tr>
<td>18.3</td>
<td>Toxicology and risk assessment</td>
<td>307</td>
</tr>
<tr>
<td>18.4</td>
<td>Occurrence of furan in coffee</td>
<td>309</td>
</tr>
<tr>
<td>18.4.1</td>
<td>Mechanisms of furan formation</td>
<td>309</td>
</tr>
<tr>
<td>18.4.2</td>
<td>Furan formation during roasting</td>
<td>310</td>
</tr>
<tr>
<td>18.4.2.1</td>
<td>Green coffee types</td>
<td>310</td>
</tr>
<tr>
<td>18.4.2.2</td>
<td>Roasting conditions</td>
<td>310</td>
</tr>
<tr>
<td>18.4.3</td>
<td>Furan levels in coffee from roasting to cup</td>
<td>311</td>
</tr>
<tr>
<td>18.4.3.1</td>
<td>Grinding</td>
<td>311</td>
</tr>
<tr>
<td>18.4.3.2</td>
<td>Consumer handling/kitchen life</td>
<td>312</td>
</tr>
<tr>
<td>18.4.3.3</td>
<td>Brewing</td>
<td>313</td>
</tr>
<tr>
<td>18.4.3.4</td>
<td>Instant coffee</td>
<td>315</td>
</tr>
<tr>
<td>18.4.3.5</td>
<td>Cup of coffee as consumed</td>
<td>315</td>
</tr>
<tr>
<td>18.5</td>
<td>Conclusion</td>
<td>316</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>316</td>
</tr>
</tbody>
</table>

Index

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>319</td>
</tr>
</tbody>
</table>