

Index

- A–PV (arterio–porto venous) concentration difference, SCFA absorption 437–8
- AAD *see* Antibiotic-associated diarrhoea (AAD)
- Acetate
- administration (humans)
 - glucose tolerance 518
 - metabolic effects 517–18
 - rectal 518
 - arterial *in vitro* and *in vivo* resistance
 - experiments 392–9
 - blood acetate 50, 447
 - colonic production 454
 - colorectal cancer 379–80
 - fibre effects, humans, bran feeding experiments 513–17
 - infants, breast-fed v. formula-fed 526
 - liver metabolism 171–7
 - enzymes 172–4
 - metabolic effects 176–8
 - substrates and hormones, influence 174–6
 - measurement by enzymatic methods 35–55
 - activation with acetyl-CoA 35–6
 - cyclic assay 44
 - interfering substances 50–2
 - metabolic pathways 36
 - sample preparation and storage 47–9
 - type-1, using acetyl-CoA 35–42
 - formation of acetyl-CoA 35–7
 - maleate dehydrogenase 37–41
 - sulphanilimide 41–2
 - type-2, acetate–acetyl phosphate cycling, hexose phosphotransferase 43–5
 - type-2, using acetyl phosphate 42–5
 - acetate kinase and hydroxylamine 42–3
 - type-3, measuring ADP 45–7
 - summary and discussion 49–53
 - metabolism
 - activation
 - in diabetes 175
 - mitochondrial 172–3
 - in starvation 175
 - activation to acetyl-CoA 484
 - antilipolytic effect 452
 - carbohydrate metabolism effects 485–8
 - concentrations and proportions in gut
 - contents, healthy v. adenoma/carcinoma 380
 - endogenous v. exogenous production in human colon 453–4
 - heat released 460
 - insulin secretion in sheep 224–9
 - synergism with glucagon 229
 - isotope dilution studies 453–4
 - lipogenesis 175–6
 - metabolizable energy in ruminants 246–51
 - oxidative acetogenesis 107, 107–17
 - reductive acetogenesis
 - bacteriology 109–12
 - competition between acetogenesis and other hydrogenotrophic activities 112–13
 - quantitative aspect of acetogenesis 113–15
 - respiratory quotient (RQ) 458–9
 - uptake by muscles 185
 - pharmacological use 428
 - radiolabelling studies 453–4
 - rumen
 - formation in 62
 - variation with diet 67–8
 - tissue extracts 48
 - peripheral venous circulation (human) 50, 447
 - transport in ruminant forestomach 133–47
 - turnover 454
 - decrease with age 454
 - utilization
 - liver 450
 - other human tissues 447–50
 - see also* Acetic acid
- Acetate kinase 36, 47
 - and hydroxylamine, acetate measurement by enzymatic methods 42–3
- Acetate thiokinase 484, 488
 - in heart tissue 488
- Acetic acid
 - absorbance change due to, formula 38–9
 - ATP production from direct oxidation 456
 - heat released in metabolism 460
 - metabolism in animals, oxidation efficiency 457
 - pK_a values, in various mixtures 23
 - resonance 23–4
 - respiratory quotient (RQ) 458–9
- Acetogenesis
 - hydrogen sink 443
 - reductive/oxidative 107–17

562 *Index*

- Acetogenic bacteria 109–12
 enumeration 109
 inhibition of methanogenesis 110
 main characteristics 108, 109–11
 radiolabelling 111–12
 various species 111
 various substrates 110
- Acetomaculum ruminis*, characteristics 108
- Acetonaemia, lactating ruminants 253–4
- Acetonea longum*, requirements 108
- Acetyl adenilic acid 49
- Acetyl-CoA
 activation of acetate 35–6
 CoA–acetate recycling 453–4
 mitochondrial 447
- Acetyl-CoA synthetase 36
 activation of SCFA 341
 inhibition 175–6
 liver 172
 mitochondrial 173
- Acetyl-CoA transferase 37
- Acetylcarnitine 47
 acylcarnitine transferase 181
- Acid–base regulation, SCFA in human colon 457–61
- Acidaminobacter hydrogeniformans*, in humans 99
- Acidaminococcus fermentans*, in humans 98
- Acidification
 and colorectal cancer 443
 in cytoplasm, by SCFA 366–8
 and methanogenesis 443
- Acidity of carboxylic acids 18–26
- Acidosis, ruminants, gastrointestinal motility 191–7
- Actin (cytoskeletal) network
 activation 367–9
 pertussis blocking 368
- Actinomycin, cancer cells, *n*-butyrate effects 277
- Acyl-CoA, activation of *n*-butyric acid 463
- Acyl-CoA dehydrogenase, genetic defects 346
- Acylcarnitine transferase, bypass 552
- Acylcarnitine transferase, inhibition, sheep liver 181
- ADP, measurement 45–6
- Albumin, bound *n*-butyrate 447
- Alcohol
 conversion to SCFA, efficiency 432–3
 liver metabolism, and acetate 428
- Alcoholism, acetate concentrations 497
- Alkaline phosphatase
n-butyrate effects 278
 colon cancer 321
- Alkanes, molecular weights, and boiling points 29
- Amino acids
 colonic
 amino acid bacteria 98
 fermentation producing SCFA 97–101
 Stickland reactions 97, 99
- Aminopeptidase, colon cancer 321–2
- Ammoniogenesis, SCFA in human colon 459
- Ammonium ion, interactions with SCFA in reticulorumen 143
- Amphibians, SCFA concentrations in hindgut 74
- Amylase, rumen protozoa 62
- Amylomaize, in rats 182–3
- Anaerobic fermentation
 BCFA production 461
 hydrogen sinks 439–41
 triglyceride production, toxicity 461
- Anaerovibrio lipolytica*, properties 60
- Animal models
 colitis 347
 neonatal model of colonic function 531–2
 SCFA studies 510–11
see also Ruminants; specific animals
- Anion transport inhibitor DIDS 394, 397
- Antibiotic-associated diarrhoea (AAD) 373–8, 462
 infants 532
- Antibiotic-induced colitis 413–14
- Antibiotics
 as feed additives, rumen dysfunction 68–9
 SCFA effects 373–8
- Antipodes, defined 17
- APC gene 328
- Apical and basolateral membranes, absorption of SCFA 162–3
- Appetite control in ruminants 257–73
 and pancreatic hormones 264–8
- Aquatic herbivores, SCFA concentrations in hindgut 75, 76
- Arabinogalactans 432
 energy as acetate, propionate and *n*-butyrate 442
- Arterial *in vitro* and *in vivo* resistance experiments 392–9
- Arterio–porto venous (A–PV) concentration difference, SCFA absorption 437–8
see also Portal venous concentrations of SCFA
- ATP production
 formation in rumen 63
 from SCFA, stoichiometry 454–7
 from various substrates 456
- Atropine, intestinal secretory response 212
- Auerbach's plexus 210
- Autonomic nervous system *see* Enteric nervous system (ENS)
- Avoparcin, feed additives 69
- Bacteria of rumen *see* Acetogenic bacteria;
 Rumen bacteria
- Bacterial infections 361–72
 bacteraemia, incidence, USA 537
 gut barrier 466
- Bacterial metabolism
 human colon, faecal protein excretion 435–6
 rat hindgut, trophic effect of SCFA 298–9
- Bacterial overgrowth, pouchitis 417
- Bacterial production of SCFA 428–30, 432, 435–6
- Bacterial translocation and sepsis, SCFA administration 466
- Bacteroides fragilis*
 infants 526–7
 SCFA released during growth 362–4, 366
- Bacteroides ovatus*
 in humans 94, 96
- Basal metabolic rate, energy contribution of SCFA 149

- BCFA (branched-chain fatty acids)
 colon 100–1, 171
 liver 171
 production in anaerobic fermentation 461
- Benzoic acid, pK_a values, in various mixtures 23
- Bicarbonate ion
 and absorption of SCFA in colon 157–8, 445–6
 and interactions with SCFA in reticulorumen 139
- Bicarbonate-induced shift to ureagenesis 459
- Bifidobacterium breve*, in humans 94, 95
- Biotin, propionate metabolism 178
- Birds, SCFA concentrations in hindgut 75–6
- Bloat 68
- Blood, *n*-butyrate 447
- Blood circulation *see* Intestinal blood circulation
- Blood–brain barrier, penetration by triglycerides 461
- Boiling points 289
- Bowel rest, SCFA administration 463, 550
- Bran feeding
 cholesterol-lowering effects 510–11
 energy as acetate, propionate and *n*-butyrate 442
 hypercholesterolaemic subjects 513–17
 large-bowel neoplasia 313
 SCFA rise in non-ruminants 498–502
- Branched-chain fatty acids *see* BCFA
- Bread, incorporation of propionate 519
- Breath hydrogen *see* Hydrogen breath test
- Bromoethane sulphonic acid, methogenesis inhibition 112–13
- Brush border membrane hydrolases 321
- Bulk, kaolin v. fermentable fibre 408
- Burn injury *see* Injury, nutritional support
- n*-Butyrate
 amylase secretion enhanced 224–5
 arterial *in vitro* and *in vivo* resistance experiments 392–9
 cell morphology and ultrastructure effects 277–80
 colon tumorigenesis 310–11, 320–3, 378–82
 neoplastic cells, paradoxical effects 326, 327–8
 colonic epithelium, normal and paradoxical 323–8
 concentrations and proportions in gut contents, healthy v. adenoma/carcinoma 380
 gene expression and regulation, effects 276–80, 282
 genetic effects 330–2
 human blood 447
 liver metabolism 182
 rats, gluconeogenesis 184–5
 metabolism
 atrophic effects 312
 β -oxidation pathway 338
 colonocytes, sulphide effects 343
 regulation 341–3
 cell proliferation effects 275–6
 colonic effects 211–13
 benefits 378
 colonocytes
 animal models 339–40
 human biopsy 339–40
 formation in rumen 63
 heat released in metabolism 460
 histone deacetylase effects 379–81
 inhibition of acetate metabolism in liver 174
 insulin secretory response 225, 296
 metabolizable energy in ruminants 246–51
 pivalyloxymethyl 282
 poly(ethylene glycol) 282
 rectal irrigation in colitis treatment 353–60
 therapeutic use 282
- n*-Butyric acid
 activation by acyl-CoA 463
 ATP production from direct oxidation 456
 heat released in metabolism 460
- Butyrivibrio fibrisolvens*, properties 60, 61, 62
- Butyryl-CoA, oxidation 446–7
- C₂, C₃, C₄ carboxylic acids *see* Acetate;
n-Butyrate; Propionate
- c-fos*, *n*-butyrate effects 280
- c-myc*
n-butyrate effects 279
 genetic rearrangements 329
- c-ras*
 and cell cycle 330–2
c-ras mutation, colorectal cancer 328–9
- Caecal motility, SCFA effects, rat, dog 199–200
- Caecectomy 415
- Caecum fermenters, v. colon fermenters, size 121
- Calcium, cellular messenger in SCFA-induced responses 226–8
- Calorimetry, classic studies in humans 458
- Cancer cells
n-butyrate effects 277
n-butyrate therapy 282
 tumorigenesis 310–11, 320–3, 326–8, 378–82
see also Colorectal cancer
- Caprylic acid (caproate)
 colonic effects 211–13
see also Octanoate
- Carbohydrate
 non-digestible *see* Lactulose
 polymerized, list and structures 88
 replacement by SCFA 182–3
 resistance to absorption in small bowel 376–7
 substrates fermented in human colon 431
 unavailable
 defined 428–9
 distribution of energy 429–30
 energy release 429
 intake and fermentability 434–5
see also Starch, resistant
- Carbohydrate intolerance, antibiotic-associated diarrhoea (AAD) 532
- Carbohydrate metabolism 483–93
 colonic 90–7, 404, 408
 conversion to SCFA, efficiency 432–3
 diabetes 489–90
 fermentation in colon 90–7, 182–3, 404, 408
 bacterial breakdown of polymers 88
 control 93–7
 major pathways 92

564 *Index*

- Carbohydrate metabolism (*cont.*)
 insulin and glucagon 489
 liver 483–8
 acetate effects 484–5
 propionate effects 485–8
 malabsorption syndromes 367–8, 381
 peripheral tissues 488–9
 propionate effects 179–81
 substrate
 ruminants
 cereal processing 245
 effect on molar proportions of SCFA 244
 see also named carbohydrates
 2,7-bis(carboxyethyl)-5(6)-carboxyfluorescein,
 leukocyte marker 366
- Carboxylic acids
 acidity 18–26
 acid dissociation 20
 electron-donating inductive effects 25–6
 electron-withdrawing inductive effects 25
 hydrogen bonding 27–8
 inductive and electrostatic effects 24
 resonance effect 19–24
 boiling points 289
 defined 15
 dimerization constant and distribution constant
 32
 hydrogen bonding 26–33
 and acidity 27–8
 dimerization constant 28–33
 and solubility in water 28
 molecular weights, and boiling points 29
 pK_a values 19, 20, 21
 various di- and tri-carboxylic acids 20
 in various solvents 22
 terminology 15–16
- Carnityl-acyl transferase system 181
 bypass 552
- Cattle
 acetogenic bacteria 111
 glucagon, role in appetite control 267
see also Ruminants
- CCPR *see* Crypt cell production rate (CCPR)
- Cell morphology and ultrastructure, *n*-butyrate
 effects 277–80
- Cell proliferation
n-butyrate effects 275–6
 differentiation 325–7
 G-1 phase, differentiation 322
 ruminant/non-ruminant digestive tract 289–305
see also Colonic epithelial cells
- Cellodextrins, digestion by rumen bacteria 61
- Cellulases
 rumen fungi 61
 rumen protozoa 61
- Cellulolysis, rumen bacteria 61–2
- Cellulose, energy as acetate, propionate and
n-butyrate 442
- Cereals
 amylo maize, in rats 182–3
 incorporation of propionate into bread 519
 processing
 effect on molar proportions of SCFA 244–5
 ruminants, effect on molar proportions of
 SCFA 245
 see also Bran feeding
- Chemistry of SCFA 15–34
 geometrical isomers 15–17
 notation 18
 optical isomers 17–18
- Children *see* Infants and children
- Chloride
 interactions with SCFA in reticulorumen 140–2
 propionate-induced secretion in colon 210–13
 role in absorption of SCFA, colon 162
- 3-Chloropropionate, cross-inhibition of
 propionate effects 217
- Cholecystokinin, release by SCFA 224
- Cholesterol, plasma
 acetate inhibition 176
 fibre and hepatic lipid synthesis 499–502
 propionate inhibition 499–500
- Cholesterol reduction
 human studies 511–23
 hypercholesterolaemic subjects 513–17
 hypotheses 509
 propionate mediation 499
- Chromatin
 proteins, phosphorylation 280
 structure and expression, *n*-butyrate effects 281
- Chromatography methods 243–4
- Clinical nutrition, short-chain triglycerides (SCT)
 537–54
- Clostridium bifermentans*, in humans 96
- Clostridium butyricum*, in humans 93
- Clostridium difficile*
 antibiotic-associated diarrhoea 373–8
 colitis 413, 415
- Clostridium formicoaceticum* 107
- Clostridium mayombeii* 109
- Clostridium perfringens*, in humans 94, 96
- Clostridium sporogenes*, in humans 96
- Clostridium thermoaceticum* 107
 acetogenesis 112
- Colitis
 animal models 347
 antibiotic-induced 413–14
- Crohn's colitis 345
 SCFA administration 464
 defined 343
 distal, management 356–9
 diversion colitis 343, 345, 413
 Hirschsprung's disease colostomy 533
 management 353–6
 SCFA administration 463–4
 management 353–60
 pouchitis 356, 417
 management 356
 pseudomembranous 413
see also Ulcerative colitis
- Collagen index, hydroxyproline 410
- Colon
 absorption of SCFA 149–70
 apical and basolateral membranes 162–3

- bicarbonate ion 157–8, 445–6
n-butyrate effects 211–13
n-caproate effects 211–13
 chain length and lipid solubility 153–5
 chloride, role 162
 colonic starvation 377
 concentration, dependence 150–1
 intracellular pH 156–7
 luminal nutrition 403–4
 model, apical and basolateral membranes 162–3
 motility effects 199–204
 paracellular pathway 155
 pH dependence 151–2
 potassium transport 162
 proton antiport systems in applied membrane 156
 sodium transport 160–1
 study methods 150
 unequal intramural fluxes 159–60
 arterial *in vitro* and *in vivo* resistance experiments 392–9
 atrophy 463
 ‘bowel rest’, SCFA administration 419–20, 463, 537, 549–50
 distal, structural requirement for stimulation of secretory response 215–17
 epithelium *see* Colonic epithelial cells
 flow dynamics of digesta 122–8
 infants
 acute infectious diarrhoea, carbohydrate fermentation 532–4
 neonatal model of colonic function 531–2
 metabolism, *see also* Energy source, SCFA in human colon
 microbiology 87–105
 potential-difference response 214–15
 production of SCFA
 amino acid fermentation 97–101
 breakdown of polymers 90, 102
 carbohydrate fermentation 90–7
 fermentation rates
 horse, pig, wombat 128–9
 human implications 129–30
 fermentation substrates 89–90
 quantitation of SCFA 101–3
 SCFA concentration, range 395
 propionate-induced secretion of chloride 210–13
 structure and motility of human colon 121–2
 tumorigenesis 310–11, 320–3, 326–8, 378–82
 animal models 307–18
 APC gene 328
 n-butyrate effects 319–35, 378–82
 major effects 319–20
 DCC gene 328
 human therapy implications 313–14
 multistep process 328–9
 role of *n*-butyrate 310
 SCFA protective mechanisms 311–13
 secretion of urokinase 328
n-valerate effects 211–13
 wall tension, Laplace law 410
see also Hindgut
 Colon fermenters
 v. caecum fermenters, size 121
 principal characteristics 129
 Colonic diversion
 post-colostomy 412–15
 see also Diversion colitis
 Colonic epithelial cells
 barrier function 337
 cell adhesion 324–5
 colon tumorigenesis 309
 differentiation as key factor in cell behaviour 322
 differentiation markers 321–2
 faecal desiccation 324
 growth indicators 402
 gut mucosal barrier 466, 537–8
 luminal nutrition, defined 403
 metabolism 337–41
 β -oxidation pathway 338
 n-butyrate metabolism, atrophic effects 312
 n-butyrate utilization 533–4
 energy supply 323, 377, 444–6
 fasting and starvation 343
 HMG-CoA β -oxidation pathway 338
 lumen trophic factor 291
 normal and paradoxical effects of *n*-butyrate 323–8
 regulation of β -oxidation of *n*-butyrate 341–3
 SCFA effects *in vivo* 289–305
 non-ruminants 296–302
 ruminants 290–6
 sodium absorption 377
 ulcerative colitis 344–6
 mitotic index 292
 proliferation and differentiation 325–7
 rectal irrigation in colitis treatment 353–60
 SCFA effects 289–305
 SCFA utilization 533–4
 Colonic starvation 377
 Colonic surgery 401–25
 Colonocytes *see* Colonic epithelial cells
 Colorectal cancer
 and acidification 443
 adenoma, hypomethylation, histones 329
 biomarker for susceptibility 466
 cell cycle, and proto-oncogenes 330–2
 colon tumorigenesis 310–11, 320–3, 326–8, 378–82
 concentrations and proportions of SCFA in gut contents, healthy *v.* adenoma/carcinoma 380
 differentiation, steps 328–9
 epidemiology 378
 and fibre 378
 genetic alterations 328–9
 pH effects 382–3
 SCFA administration 466–7
 wheat-bran study 313
 Coprophagy (faecal refection), and SCFA studies 501
 Coronary artery disease 451

566 *Index*

- Coupled non-ionic diffusion 11
 Cow *see* Cattle; Ruminants
 Crohn's colitis 345
 SCFA administration 464
 Crotonate, cross-inhibition of propionate effects 217
 Crypt cell production rate (CCPR) 297–8
 Cycloheximide, cancer cells, *n*-butyrate effects 277
 Cytoplasmic acidification, by SCFA 366–8
 Cytosine, hypermethylation 280
 Cytoskeletal network, activation 367–9
 Cytosolic activation, ATP production from direct oxidation 456
- DCC gene 328
 Dehydroxylate, intestinal secretory response 212
 Diabetes mellitus
 acetate effects on carbohydrate metabolism 489–90
 acetate utilization 185
 lactulose, oral glucose tolerance in non-insulin-dependent diabetes 488
 thermogenesis 451–2
 Dialysis, metabolism of acetate 428
 Dialysis capsules 8–10
 Diaminopeptidylpeptidase, colon cancer 321–2
 Diarrhoea
 antibiotic-associated (AAD) 373–8, 462
 infants with acute infectious diarrhoea, carbohydrate fermentation 532–4
 post-operative, sodium absorption and SCFA 312
 prevention strategies 463
 SCFA administration 462–3
 DIDS anion transport inhibitor 394, 397
 Dietary fibre *see* Fibre
 Dietary sources of SCFA 428–33
 Digestive systems, historical notes
 human gut 5–10
 in vivo faecal dialysis 8–10
 non-ruminant studies 3–5
 ruminant studies 2–3
 Digestive tract, hind *see* Colon; Hindgut
 Dimerization 28–33
 Dimerization constant 28–33
 and distribution constant, carboxylic acids 32
Diploplastron affine, properties 62
 Dipole interactions *see* Hydrogen bonding
 Dipole moment, defined 24
 Distribution constant, and dimerization constant, carboxylic acids 32
 Diversion colitis
 fasting/starvation 343, 345
 following surgery 413
 Hirschsprung's disease colostomy 533
 management 353–6
 SCFA administration 463–4
 DNA hyperacetylation, colon tumorigenesis 310–11
 DNA methylation, *n*-butyrate effects 280, 330
- Dog
 colonic effects of SCFA 199–200
 gastric and small-intestinal responses to SCFA 198–9
 SCFA concentrations in hindgut 77–9
 Dugong, SCFA concentrations in hindgut 75
 Dumping syndrome, peptide tyrosine (PYY) 300–1, 313
- Electrostatic effects of acids and ions 24–6
 Embden–Meyerhof–Parnas pathway 64
 Enamel, salivary composition and SCFA 239
 Enema
 n-butyrate, ulcerative colitis 467
 retrograde administration of SCFA 420–1
 Energy
 bacterial, efficiency of conversion 436
 total metabolizable (ME) 434–5
 Energy source, SCFA 10–11
 ratio (acetate:propionate:*n*-butyrate) 436
 Energy source, SCFA in human colon 10–11, 427–81
 acid–base regulation 457–61
 ammoniogenesis 459
 contribution to energy requirements 434–9
 based on arterio–venous exchanges 437–8
 faecal protein excretion 435–7
 intake of unavailable carbohydrates 434–5
 supply limiting metabolism 438
 endogenous v. exogenous acetate production 453–4
 heat production 458–9, 460
 interorgan transport and systemic metabolism 446–53
 intestinal surgery 403–4
 percentage of energy intake 435
 proportion of requirement met by SCFA 435–6
 sources in diet 428–33
 other unavailable carbohydrates 430–3
 unavailable starch 428–9
 stoichiometry of ATP production from SCFA 454–7
 stoichiometry of fermentation 439–44
 n-butyrate as major hydrogen sink 441–3
 hydrogen sinks during anaerobic fermentation 439–41
 inferences 443–4
 unavailable carbohydrates, distribution of energy 428–30
 uptake from colon 444–6
 ureagenesis 459
 Energy source, SCFA, in ruminants 243–56
 metabolizable energy 246–51
 see also Liver, SCFA metabolism
 ENS *see* Enteric nervous system (ENS)
 Enteral feeding, fibre-free, effects 463, 538–9
 Enteric nervous system (ENS) 209–10
 neuroblocking agents, effects on intestinal secretory response 212
 secretory response to reflex 213–14
 stimulation by SCFA 405–7
 vagal receptors 196–7

- Enteroglucagon
 location of secretory cells 408
 monitoring of SCFA 408
 trophic effects of SCFA 300–1
see also Glucagon
- Enterotrophic effects of SCFA *see* Trophic effects of SCFA
- Enterotrophic GI hormones
 stimulation by SCFA 278–9, 407–9
see also Enteroglucagon; Gastrin; Intestinal peptide YY
- Epithelial cells *see* Colonic epithelial cells
- Escherichia coli*
n-butyrate oxidation 343
 infants 528
 SCFA inhibiting phagocytic cell function 363–4
- Ethanol
 conversion to SCFA, efficiency 432–3
 liver metabolism, and acetate 428
- Eubacterium limosum*
n-butyric acid production 111
 requirements 108, 109
- Eubacterium ruminantium*, properties 62
- FAD dehydrogenase, ‘suicide inactivation’ by propionyl CoA 181
- Faecal dialysis *in vivo*
 historical notes 8–10
 ionic composition 8
- Faecal protein excretion, human colon, measure of bacterial metabolism 435–6
- Faecal SCFA 373–89
 and colonic cancer 378–82
 pH effects 382–3
 infants 512, 526–31
 ratios 511, 512
 reflection 501
- Familial adenomatous polyposis
 risk of carcinoma 415
 SCFA investigations 313–14
 steps 328–9
 wheat-bran study 313
- Fermentation, stoichiometry 439–44
- Fibre
 cholesterol-lowering action 495, 499–504
 and colorectal cancer 378
 feed for ruminants
 v. concentrates 243, 254–5, 295
 hay and grass 238–9
 fermentability
 propionate effects 180–1
 and tumorigenesis 307–8
 hepatic lipid synthesis, plasma cholesterol and 499–502
 intake, European countries 430–1
 lipid-lowering effect 183–4
 low-fibre diets 404
 protective role in colon tumorigenesis 307–8, 378
 SCFA rise in non-ruminants 498–502
 and total food intake 452
 wheat-bran study, large-bowel neoplasia 313
 see also Arabinogalactans; Bran feeding; Cellulose; Guar gum; Pectin; Polysaccharides; Xylan
- Fibre-containing diets
 LDL-cholesterol studies 515–17
 serum acetate 513–17
- Fibre-free enteral feeding, diarrhoea 463
- Fibrobacter succinogenes*, properties 60, 61
- Fish, SCFA concentrations in hindgut 75
- Flow dynamics of digesta 122–8
 application of chemical reactor theory 123–5
- Forestomach *see* Reticulorumen
- Fructose isomers 431–2
- Fumaric acid, pK_a values, effect of hydrogen bonding 27
- Fungi of rumen 61
- Fusobacterium nucleatum*, in humans 97, 98
- G-proteins 330
- Galactose, of milk 431–2
- Gastric responses to SCFA 198–9
- Gastrin, trophicity to GI segments 407–8
- Gastrointestinal motility
 motor effects of SCFA
 modulation 191–7
 physiological implications 202–4
 ruminants/non-ruminants 191–207
 sensory mechanisms for SCFA 209–21
 Gene expression, *n*-butyrate effects 276–80
- Gene promotion and regulation, *n*-butyrate effects 282
- Geometrical isomers 15–17
- Globin gene, *n*-butyrate effects 276
- Glucagon
 carbohydrate metabolism 489
 and oral acetate 450
 role in appetite control
 ruminants 267–8
 sheep 267
 secretory response in sheep
 n-butyrate infusion 225
 cell proliferation 294–5
see also Enteroglucagon
- Gluconeogenesis
 effects of acetate and propionate 485
 enzymes, activity 175
 human, and ethanol 184
 propionate as substrate 179
 3-C substrates (propionate, lactate, alanine) 179
 ruminants 496
 propionate metabolism 184–5
- Glucose
 ATP production from direct oxidation 456
 glycolysis and gluconeogenesis, tricarboxylic acid cycle 485
 metabolism, acetate effects 517–18
 replacement by SCFA, metabolic consequences in the liver 182–4
- Glucose deficiency, lactating ruminants 253–4
- Glucose intolerance 451

568 *Index*

- Glucose tolerance, administration of acetate, diabetic v. normal (humans) 518
- Glutamine
ileal pouch 464–5
small bowel nutrition 401
- Glycerols of SCFA
ATP production from direct oxidation 456
enteral nutrition 428
- Glycine, pK_a values, in various mixtures 23
- Grains *see* Cereals
- Grass feeding 238–9
- Guar gum
conversion to SCFA, efficiency 432–3
glucagon levels 489
gum arabic, energy as acetate, propionate and *n*-butyrate 442
- Guinea pig
energy contribution of SCFA to BMR 149
propionate, colonic effects 213
SCFA absorption from hindgut 149–65
unidirectional fluxes 154
- Gut contents, SCFA concentrations and proportions 380
- Gut epithelial cells *see* Colonic epithelial cells
- Gut mucosal barrier, bacterial infections 466, 537–8
- Haemoglobin, *n*-butyrate effects 276
- Hartmann's procedure, *in vivo* effects of SCFA in patients 392
- Hay and grass 238–9
see also Fibre
- Head injury *see* Injury, nutritional support
- Heart tissue, acetate thiokinase 488
- Heat production, SCFA in human colon 458–9, 460
- Hepatic lipid synthesis, fibre, plasma cholesterol and 499–502
- Hepatic metabolism of SCFA
non-ruminant studies 497–8
ruminant studies 496–7
- Hepatic steatosis, LCT *i.v.* 539
- Hexamethonium, intestinal secretory response 212
- Hexokinase, contaminant of acetate 47
- Hexose phosphotransferase–acetyl phosphate, acetate measurement by enzymatic methods 43–5
- Hindgut
caecum fermenters v. colon fermenters, size 121
endogenous SCFA utilization 81
epithelial cells, SCFA effects *in vivo* 296–302
horse 125
microbiological aspects 87–105
SCFA concentrations
as indicators of microbial fermentation 80–1
various species 73–80
SCFA sensation, physiological significance 219
see also Colon; Colonic
- Hirschsprung's disease, inflammation following colostomy reversed by bowel continuity restoration 533
- Histone deacetylase, *n*-butyrate effects 379–81
- Histones
hyperacetylation
n-butyrate effects 280
colon tumorigenesis 310–11
hypomethylation, colonic adenoma 329
phosphorylation 280
- Historical notes
colonic epithelial cells 337–40
non-ruminant studies 3–5
ruminant studies 2–3
SCFA as energy source 10–11
- HMG-CoA β -oxidation pathway, colonocytes 338
- HMG-CoA reductase, activity, and MCFA 183
- Holotrichs, rumen protozoa 60–1
- Hormone receptors, *n*-butyrate effects 278
- Hormones
n-butyrate effects 278, 279
pituitary glycoprotein hormones, *n*-butyrate effects 278
vitamin D₃, *n*-butyrate modulation of effects 281
- Horse
colonic SCFA production 128–9
energy contribution of SCFA to BMR 149
hindgut 125
SCFA absorption from hindgut, unidirectional fluxes 154
SCFA concentrations in hindgut 79
- Human gastric and small-intestinal responses to SCFA 199
- Human large bowel *see* Colon
- Human salivary flow, SCFA effects 239
- Hydrogen bonding
carboxylic acids 26–33
and acidity 27–8
- Hydrogen breath test, malabsorption syndromes 373, 381
- Hydrogen sinks, during anaerobic fermentation 439–41
- Hydroxylamine, and acetate kinase, acetate measurement by enzymatic methods 42–3
- Hydroxyproline, collagen index 410
- Hyrax, energy contribution of SCFA to BMR 149
- Ileal brake 203
- Ileal pouch
glutamine 464–5
ileo–anal pouchitis 356, 417, 464–5
post-total proctocolectomy 415–18
- Infants and children 525–35
carbohydrate fermentation 530
development of bacterial flora 525–31
faeces
breast-fed v. formula-fed 526
faecal flora 526–31
historical notes on SCFA 525–6
lactose in feeds, and antibiotic-associated diarrhoea (AAD) 532
- Inflammatory bowel disease
peptide tyrosine (PYY) 300–1, 313
TPN and bowel rest 419–20, 463, 537, 549–50
- Inflammatory reaction 361–5
- Injury, nutritional support 541–54
metabolic response 541–2, 544–5

Index

569

- SCT as non-glucose calorie source 545–9
 TPN with triacetin 542–4
- Insects, SCFA concentrations in hindgut 74–5
- Instillation of SCFA, rectal 353–60, 392, 398–9
- Insulin
 carbohydrate metabolism 489
 lactating ruminants 253–4
 mitotic index effects 294
 resistance 451
 role in appetite control 264–7
 rumen, and SCFA as trophic factor 294
 secretion in sheep 225–9
 secretory response, *n*-butyrate infusion 225
 stimulus–secretion coupling model 228
- Insulin–pancreatic–acinar axis 223–31
- Interferons, *n*-butyrate effects 281–2
- Interorgan transport, and systemic metabolism 446–53
- Intestinal blood circulation 391–400
 arterial *in vitro* relaxation experiments 392
in vivo effects of SCFA in Hartmann's procedure patients 392
 stimulation, rationale for use of SCFA in intestinal surgery 404–5
- Intestinal and colonic surgery 401–25
 colonic anastomosis, SCFA administration 410–12, 465–6
 postcolostomy colonic diversion 412–15
 rationale for use of SCFA 402–3, 402–9, 550–1
 enterotrophic GI hormones 407–9
 luminal contact and provision of energy 403–4
 pancreatobiliary secretions 405
 stimulation of autonomic nervous system 405–7
 stimulation of intestinal blood flow 404–5
 resection, TPN with SCFA supplementation 550–1
 risks/benefits of use of SCT 551–2
- Intestinal disease and injury *see* Injury, nutritional support
- Intestinal peptide YY (PYY)
 location of secretory cells 408–9
 trophic effects of SCFA 300–1, 313, 408–9
- Intestinal secretory response 198–9
 adaptation 214–15
 neuroblocking agents, effects 212
see also Enteric nervous system (ENS)
- Intestine, motility *see* Gastrointestinal motility
- Inulin 431
- Ionic strength, defined 19
- Ionogram, *in vivo* faecal dialysis 9
- Ionophores, feed additives 69
- IP3, calcium channel opening 228
- Isomers of SCFA 15–18
cis and *trans*, defined 17
 notation 18
- Isotope dilution, SCFA production measurement 126–8
- IUPAC nomenclature of SCFA 15–16
- Jejunal morphometrics, rat, SCFA effects 405–7
- K^+/H^+ antiport 445
- Kangaroo, forestomach, SCFA production 125–8
- Kaolin, v. fermentable fibre, bulk, study 408
- Ketogenesis
 acetate utilization by liver 450
 from *n*-butyrate, colon 338
 SCT infusion 552
- Ketosis, lactating ruminants 253–4
- Kidney dialysis, metabolism of acetate 428
- Krebs cycle 485
 acetate utilization 185
- Kwashiorkor 343
- Lachnospira multiparus*, properties 60
- Lactate
 absorption 444
 and acetate uptake 497–8
 infants, breast-fed v. formula-fed 526
 interference with gastrointestinal motility 193–6
 interference with liver metabolism of SCFA 176–7
 metabolism by rumen organisms 65
- Lactation, ruminants 253–4
- Lactic acidosis
 human 461
 rumen dysfunction 68
- Lactobacillus bifidus*, breast-fed infants 525–8
- Lactose
 infant feeding
 and antibiotic-associated diarrhoea (AAD) 532
 carbohydrate fermentation effects 530
- Lactulose
 acidification of stool 443
 availability to absorption 432, 513
 effects on serum acetate levels 513
 effects on serum triglyceride levels 484
 energy as acetate, propionate and *n*-butyrate 442
 hydrogen breath test 373
 and oral glucose tolerance in non-insulin-dependent diabetes mellitus 488
- Laplace law 392
 tension of bowel wall 410
- Large bowel (intestine) *see* Colon; Hindgut; named species
- Large-bowel epithelium *see* Colonic epithelial cells
- Large-bowel neoplasia *see* Colorectal cancer
- Lasalocid, feed additive 69
- LCT *see* Long-chain triglycerides
- LDL-cholesterol studies 515–17
- Leukocytes
 inhibition, mechanisms 365–9
 phagocytic killing capacity, SCFA effects 363
 superoxide production, SCFA effects 367
- Lidocaine, intestinal secretory response 212
- Lipid emulsion, intravenous 538–9
- Lipid metabolism
 human studies 511–23
 lipogenesis
 abnormal, ruminants 251–3

570 *Index*

- Lipid metabolism (*cont.*)
 acetate as substrate
 enzymes, activity 175
 inhibition 176
 glucose v. alcohol as substrate 451
 propionate effects 502–4
 propionate effects *in vitro* 502–4
- Liposomes, *n*-butyrate encapsulation 379–81
- Liver
 carbohydrate metabolism 179–81, 483–8
 disease states
 hepatic coma 448
 hepatic steatosis, LCT intravenous 539
 lipid synthesis, fibre, plasma cholesterol 499–502
 metabolism of ethanol to acetate 428
 steroid metabolism, and large-bowel SCFA 502
- Liver, SCFA metabolism 171–90, 467, 495–8
 acetate 171–7
 adaptation to high fermentable carbohydrate diet 175
 comparative aspects 184–5
 lactate interference 176–7
 and lipid metabolism 498–502
 non-ruminants 497–8
 propionate 177–81
 effects on carbohydrate metabolism 179–81, 483–8
 ruminants 496–7
 SCFA extraction 447
 and triacylglycerols 495–6
see also named SCFA and organisms
- Long-chain triglycerides, as intravenous lipid emulsion in nutrition 538–9
- Low-density lipoproteins (LDL)
 LDL-cholesterol, fibre-containing diets 515–17
 and VLDL secretion by hepatocytes 495–6
- Lumen trophic factor 291–302
- Magnesium ion, interactions with SCFA in reticulorumen 142
- Malabsorption syndromes
 carbohydrate 376–7, 381
 infants 533–4
 hydrogen breath test 373, 381
 peptide tyrosine (PYY) 300–1, 313
- Malate dehydrogenase, measurement of acetyl-CoA 37–41
- Maleic acid, pK_a values, effect of hydrogen bonding 27
- Maltitol 433
- Manatee, SCFA concentrations in hindgut 75
- Mannitol 433
- Marsupial GI tract
 kangaroo 125
 wallaby 126
- MCT *see* Medium-chain triglycerides
- ME (metabolizable energy) 246–51, 434–5
- Medium-chain triglycerides, as alternative to LCT 539
- Megasphaera elsdenii*, properties 60, 63, 65
- Metabolizable energy, energy sources 246–51, 434–5
- Metallothionein, *n*-butyrate effects 278
- Methanobrevibacter ruminantium*, properties 60
- Methanogenesis
 and acidification 443
 inhibition by bromoethane sulphonic acid 112–13
 stoichiometry 439–41
- Methylmalonic aciduria 178
- Methylmalonyl-CoA 485
- Mitochondrial oxidation
 activation, ATP production 456
 defects, SCFA and 342, 346
 TCA cycle 485
- Mitotic index
 epithelial cells 292
 insulin effects 294
- Monensin, feed additive 69
- Monoacetacetin, monobutyryl, heat released in metabolism 460
- Mucosal and submucosal plexus 210
- Mucosal barrier 537–8
- Myenteric (Auerbach's) plexus 210
- N-ras*, *n*-butyrate effects 280
- Na^+/H^+ antiport 162, 445, 462
- Neosugar 432
- Neuroblocking agents, effects on intestinal secretory response 212
- Neurological injury *see* Injury, nutritional support
- Nomenclature of SCFA
 IUPAC 15–16
 polarized light 17–18
 S/R system 18
- Non-starch polysaccharides (NSP) *see* Fibre
- Nutrition, clinical, short-chain triglycerides (SCT) 537–54
- Octanoate
 increase of calcium in pancreatic cells 226
 inhibition of acetate metabolism in liver 174
 inhibition of *n*-butyrate metabolism in liver, rat 463
- Oleate, inhibition of acetate metabolism in liver 174
- Oligosaccharides
 heats of combustion 433
 raffinose 432
- Oncogenes, *n*-butyrate effects 279–80, 330–2
- Ophryoscolecidae, rumen protozoa 60–1
- Ophryoscolex caudatus*, properties 62
- Optical isomers 17–18
 enantiomers, defined 17
- Ornithine decarboxylase, colonic mucosa 402
- Osmoreceptors, rumen 264
- Oxalate, conversion to SCFA 432
- p53 gene, cancer and adenoma 329
- Pancreatic hormones, ruminants, appetite control 264–8
- Pancreatic secretion, effect of SCFA
 exocrine/endocrine 223–31
 cellular mechanisms 226–8

- clinical implications 228–9
- structural requirements for SCFA 225–6
- Pancreatobiliary secretions, use of SCFA in intestinal surgery 405
- Parenteral feeding *see* Total parenteral nutrition infusion
- Pectin
 - anticolitis effects 463
 - antidiarrhoea effects 463
 - conversion to SCFA
 - as acetate, propionate and *n*-butyrate 442
 - efficiency 432–3
 - nutritional effects 409–10
- Pentose phosphate pathway, acetate effects 484
- Peptide tyrosine *see* Intestinal peptide YY (PYY)
- Peptostreptococcus anaerobius*, in humans 96
- Peptostreptococcus productus*, requirements 108, 109
- Peripheral vein, SCFA ratios, humans 512
- Peroxisomes, acetogenesis 173
- Pertussis toxin, blocking actin polymerization 368
- pH
 - and colon carcinogenesis 378–82
 - gastric and small-intestinal responses to SCFA 199
 - pH dependence, absorption of SCFA 151–2
 - pH-partition hypothesis 151–2
- Phagocytic cell function 361–72
- Phosphofructokinase, glycolytic flux 484
- Phospholipids, SCFA solubility 33
- Phosphotransacetylase 36
- Phycomycetes, rumen fungi 61
- Pig
 - colonic SCFA production 128–9
 - absorption 149–65
 - unidirectional fluxes 154
 - acetogenic bacteria 111–12
 - concentrations 79
 - energy contribution of SCFA to BMR 149
 - propionate effects on lipid metabolism 502–4
 - gut, gross morphology 120
 - insulin
 - and adiposity 267
 - and satiety control 266
 - neonatal, model of colonic function 531–2
- Pituitary glycoprotein hormones, *n*-butyrate effects 278
- pK_a values, defined 19
- Plasminogen activation inhibitor-1 (PAI-1) 319
- Plug-flow reactor theory 123–5
- PMNs *see* Leukocytes
- Polarized light, optical isomers, *dextro* and *laevo* 17–18
- Polyplastron multivesiculatum*, properties 62
- Polysaccharides
 - cell-wall 432–3
 - heats of combustion 433
 - non-starch (NSP) *see* Fibre
 - polydextrose, conversion to SCFA, efficiency 432–3
 - substrates fermented in human colon 431
 - see also* Fibre; named polysaccharides
- Porphyromonas asaccharolytica*, in humans 98
- Portal venous concentrations of SCFA
 - arterio–porto venous (A–PV) concentration difference 437–8
 - and hepatic lipid metabolism 498–9
 - human studies 511–13
 - non-ruminants 497–8
 - SCFA ratios 512
- Post-colostomy colonic diversion 412–15
- Potassium ion, and absorption of SCFA, colon 162
- Pouchitis 356, 417
 - SCFA administration 464–5
 - see also* Colitis
- Poultry, SCFA absorption from hindgut 149–65
- Prevotella ruminicola*, properties 60, 61, 62
- Primates, SCFA concentrations in hindgut 80
- Propionate
 - administration (humans)
 - chronic 519
 - metabolic effects 518–19
 - oral, incorporation into bread 519
 - analogues 216–17
 - arterial *in vitro* and *in vivo* resistance experiments 392–9
 - human blood 447
 - liver metabolism 177–81
 - effects on carbohydrate metabolism 179–81
 - and lipid metabolism 181
 - metabolism
 - antiketogenic effects 181
 - carbohydrate metabolism effects 485–8
 - colorectal cancer 379
 - concentrations and proportions in gut contents, healthy v. adenoma/carcinoma 380
 - cross-inhibition by crotonate 217
 - effects on lipid metabolism 502–4
 - formation in rumen 62–3
 - from crossfeeding 65
 - heat released in metabolism 460
 - inhibition of acetate metabolism in liver 174
 - inhibition of starch digestion 431
 - intestinal secretory response 212–14
 - lipid metabolism effects, *in vitro* 502–4
 - metabolizable energy in ruminants 246–51
 - pathway in liver 178
 - rats, gluconeogenesis 184–5
 - ruminants, gluconeogenesis 184–5
- Propionate-induced secretion of chloride, colon 210–13
- Propionic acid
 - ATP production from direct oxidation 456
 - heat released in metabolism 460
 - infants, breast-fed v. formula-fed 526
- Propionyl-CoA 485
- Propionyl-CoA synthetase, conversion to methylmalonyl-CoA synthetase and succinyl-CoA 177–8
- Protein, colon, fermentation producing SCFA 97–101
- Proto-oncogenes *see* Oncogenes

572 *Index*

- Proton antiport systems in applied membrane,
 SCFA in colon 162, 445, 462
- Protozoa of rumen 60–1
- Pseudomembranous colitis 413
- Pseudomonas aeruginosa* 417
- Pyruvate carboxylase, propionate metabolism,
 effects 179
- Pyruvate–ferredoxin oxidoreductase 62
- PYY *see* Intestinal peptide YY (PYY)
- Rabbit and other lagomorphs
 energy contribution of SCFA to BMR 149
 PYY, interaction with ENS 408
 SCFA concentrations in hindgut 77, 78
- Raffinose oligosaccharides 432
- Rat
 acetogenic bacteria 111
 caecal motility, SCFA effects 199–200
 cholesterol-fed 510
 colon
 effects of SCFA 199–200
 SCFA absorption 149–65
 unidirectional fluxes 154
 structural requirement for stimulation of
 secretory response 215–17
 coprophagy (faecal refection) and SCFA studies
 501
 fibre, fermentation, propionate effects 180–1
 gastric and small-intestinal responses to SCFA
 198–9
 gut, gross morphology 120
 jejunal morphometrics, SCFA effects 405–7
 liver, *n*-butyrate metabolism 184–5
 SCFA as lumen trophic factor 296–302
 starch diet, glucose replacement by SCFA 182–3
- Rectal, *see also* Colorectal
- Rectal instillation of SCFA 392, 398–9
 in colitis treatment 353–60
- Reptiles, SCFA concentrations in hindgut 74, 75
- Respiratory quotients (RQ) 458–9
- Reticulorumen (and rumen)
 biochemistry 61–5
 diet
 acetate, variation with diet 67–8
 effects of SCFA infusions on food intake,
 rumen fluid 261–4
 food intake, effects on blood SCFA 258
 and saliva secretion 237–9
 dysfunction
 antimicrobials, feed additives 68–9
 bloat 68
 lactic acidosis 68
 epithelial cells, SCFA effects *in vivo* 290–6
 functions 57–8, 133–4
 microbiology 57–71
 metabolic pathways 58
 motility
 other gut segment SCFA effects 192–3
 ruminal SCFA effects 192
 SCFA properties that inhibit 193–7
 mechanisms 196–7
 osmolality of rumen fluid 262–4
 transport of SCFA 133–47
 capacity for absorbing SCFA 134–6
 influence of:
 diet 135, 136
 pH 137, 138
 SCFA chain length and metabolism 137–9
 SCFA concentration 137
 interactions with:
 ammonium ion 143
 bicarbonate 139
 chloride 140–2
 magnesium 142–3
 sodium 140
 mechanisms 137–43
 methods 134
 summary and conclusions 143–4
see also Rumen; Ruminants
- Retinoic acid, *n*-butyrate, modulation of effects 281
- Ricinoleate, intestinal secretory response 212
- Rodents, SCFA concentrations in hindgut 77, 78
- Roughage *see* Fibre
- Rumen bacteria
 microbial physiology
 carbohydrate fermentation, major pathways
 and species 92
 cellulolysis 61–2
 cross-feeding and hydrogen transfer 65–6, 67
 dietary effects 67–8
 protein metabolism 64
 regulatory mechanisms 66–7
 SCFA production from pyruvate 62–4
 principal genera 59–60
 properties 60
 substrates and products 60
- Rumen fungi, cellulases 61
- Rumen protozoa, cellulases 61
- Ruminants
 appetite control
 feeding behaviour 257–73
 glucagon 267–8
 insulin 264–7
 digestive tract
 historical studies 2–3
see also Reticulorumen
 energy sources, SCFA utilization 243–56
 absorption of SCFA 245
 caecal effects of SCFA 199–200
 carbohydrate substrate, effect on molar
 proportions of SCFA 244–5
 fat synthesis, abnormal 251–3
 food intake 257–73
 concentrates v. roughage 243, 254–5
 effects on blood SCFA 258
 effects on rumen SCFA 259
 effects of SCFA infusions on food intake
 blood 259–61
 rumen fluid 261–4
 hay and grass 238–9
 forestomach *see* Reticulorumen
 hepatic metabolism 496–7
 lactation 253–4
 pancreatic hormones, appetite control 264–8

- saliva, composition and SCFA 233–9
 SCFA
 as lumen trophic factor 290–6
 stimulation of insulin secretion 225, 452
see also named examples of ruminants
Ruminobacter amylophilus, properties 60, 62
Ruminococcus albus, properties 60, 61
Ruminococcus flavefaciens, properties 60, 61
- S/R system 18
 Salinomycin, feed additive 69
 Salivary flow
 humans 239
 non-ruminants 233
 ruminants 233–9
 SCFA in mouth 235–7
 SCFA in reticulorumen 237–8
 Salting effects 31
 Satiety
 control in ruminants 257–73
 glucagon control in humans 267
 SCFA
 absorption, role of chloride 162
 acidic forms v. salt forms 459
 administration, practical aspects 420–1
 antimicrobials
 effects 373–8
 as feed additives 68–9
 ATP production, stoichiometry 454–7
 bacterial infections, effects 361–72
 chemistry 15–34
 chain length, and lipid solubility 153–5
 colon 73–85
 colon concentration, human 395
 colonocyte metabolism, pathway 342
 defined 1–2
 energy *see* Energy source, SCFA in human colon
 energy ratio (acetate:propionate:*n*-butyrate) 436
 enterotrophic effects, possible mechanisms 403
 gastrointestinal motility
 motor effects 191–207
 sensory mechanisms 209–21
 gut contents, concentrations and proportions 380
 hepatic metabolism 171–90
 extrahepatic metabolism 185
 non-ruminant studies 497–8
 ruminant studies 496–7
 hindgut 73–85
 in human diet 239
 as lumen trophic factor
 rat 296–302
 ruminants 290–6
 mucosal metabolism 171
 pancreatic secretion effects 223–31
 phagocytic cell function effects 361–72
 pharmacological use 428
 production, isotope dilution 126–8
 ratios, humans, portal vein 512
 rectal instillation 353–60, 392, 398–9
 rectal irrigation in colitis treatment 353–60
 relaxant effects in colonic arteries 392–9
 respiratory quotients (RQ) 458–9
 rumen 57–71
 acetate, variation with diet 67–8
 SCFA stimuli, effect on GI function 210–13
 SCFA-sensitive receptors, non-ruminants 201–2
 sensation in hindgut, physiological significance 219
 substrates 460
 useful in metabolic studies 460
 supplementation of TPN 550–4
 potential future use 552–4
 risks/benefits of SCT 551–2
 supply, limiting metabolism 438–9
 transport in ruminant forestomach 133–47
 trophic effects 291–302, 313, 398, 402–9, 541
 CCPR 297–8
 use
 acidic forms v. salt forms 459
 in colonic surgery 401–25
 Western diet
 percentage of energy intake 435
 total metabolizable energy (ME) 434
 see also Acetate; *n*-Butyrate; Propionate
- SCFA receptor
 characterization 218–19
 rat colon, structural requirement for
 stimulation of secretory response 215–17
 SCT *see* Short-chain triglycerides (SCT)
 Secretin, release by SCFA 224
Selenomonas ruminantium, properties 60, 62, 63, 65, 66, 69
 Sensory mechanisms for SCFA 209–21
 adaptation 214–15
 cross-adaptation and self-adaptation 214
 chemosensation in GI tract 209–10
 effect on GI function 210–13
 structural requirement for stimulation of
 secretory response 215–17
- Sheep
 acetogenic bacteria 111
 caecal motility, SCFA effects 199–200
 glucagon, role in appetite control 267
 insulin secretion 225
 reticuloruminal motility and SCFA infusion 194–5
 SCFA absorption from hindgut, unidirectional fluxes 154
see also Ruminants
- Short-bowel syndrome 418
 SCFA administration 465, 550
 Short-chain triglycerides (SCT) 460, 537–54
 heat released in metabolism 460
 infusion, ketogenesis 552
 metabolism 460, 539–40
 non-ruminant studies 497
 potential future use 552–4
 risks/benefits 551–2
 trophic effects 541
- Sickle cell anaemia, *n*-butyrate therapy 277, 282
 Silage 238–9
 Small intestine *see* Intestinal
 Smooth muscle of GI tract, effect of SCFA on contractility 202

574 *Index*

- Sodium
 absorption by colonic epithelial cells 377
 post-operative diarrhoea 312
 interactions with SCFA in reticulorumen 140
 transport, interactions with SCFA 160–1
- Sodium hydrogen sulphide, effects on β -oxidation pathway 343
- Sodium mercaptoacetate 343, 347
- Sodium sulphite 343
- Sodium/hydrogen antiport 162, 445, 462
- Solvent extraction 31
- Sorbitol 433
- Sporomusa termitida*, characteristics 108, 111, 113
- Starch
 breakdown in rumen 62
 energy as acetate, propionate and *n*-butyrate 442
 malabsorption syndromes 381
 resistance to absorption in small bowel 182–3, 376–7
 resistant
 defined 430
 feeding experiments 182–3
 SCFA rise in non-ruminants 498
 unavailable, distribution of energy 428–30, 434–5
- Starch diet, rat, glucose replacement by SCFA 182–3
- Stickland reactions
 amino acids 97, 99
 electron donors 99
- Stoichiometry
 ATP production 454–7
 fermentation 439–44
- Streptococcus bovis*, properties 60, 62, 68
- Succinate
 leukocyte inhibition 366
 production 461
 protonation 365
- Succinomonas amylolytica*, properties 62
- Succinyl-CoA 485
- Sugar alcohols, conversion to SCFA, efficiency 432–3
- Sulphanilamide, measurement of acetyl-CoA 41–2
- Sulphate reduction 443
 and methanogenesis 439–41
- Sulphide, effects on colonocytes, β -oxidation pathway 343, 347
- Surgery *see* Intestinal and colonic surgery; *specific procedures*
- Sympathetic nervous system *see* Enteric nervous system (ENS)
- TCA cycle 485
- Teeth, enamel, salivary composition and SCFA 239
- Teleosts, SCFA concentrations in hindgut 75
- Termites, acetogenic bacteria 111–14
- Tetrodotoxin, intestinal secretory response 212
- β -Thalassaemia, *n*-butyrate therapy 277, 282
- Thermogenesis, acetate, normal and diabetic subjects 451–2
- Total parenteral nutrition (TPN) infusion
 administration of SCFA 418–21
 and blood–brain barrier 461
 effects on mucosa 537
 LCT as intravenous lipid emulsion in nutrition 538–9
 MCT as alternative 539
 with SCFA supplementation 550–1
 potential future use of SCT 552–4
 risks/benefits of SCT 551–2
 TPN-induced bowel rest 419–20, 463, 537, 549–50
see also Triacetin; Tributyrin
- TPN *see* Total parenteral nutrition (TPN) infusion
- Transport of SCFA, reticulorumen 133–47
- Triacetin
 advantages over tributyrin 551–2
 structure 540
- Triacetin, Tributyrin, Tripropionin, *see also* Short-chain triglycerides
- Triacylglycerols (TAG), metabolism, and hepatic fatty-acid metabolism 495–6
- Tributyrin
 disadvantages 551–2
 structure 540
- Tricarboxylic acid (TCA) cycle 485
- Triglycerides
 blood–brain barrier 461
 production in anaerobic fermentation 461
 serum levels, lactulose effects 484
 short-chain, medium-chain, long-chain *see these headings*
- Tripropionin, side effects 553
- Trophic effects of SCFA 291–302, 313, 398, 402–9
 direct intraluminal infusion 541
 mechanisms
 possible mechanisms (flow chart) 403
 rat 296–302
 ruminants 290–6
- Trypticase, breakdown products, rumen 64
- Tyrosine aminotransferase, *n*-butyrate effects 182
- Ulcerative colitis
 acyl-CoA dehydrogenase, genetic defects 346
n-butyrate enemas 467
 distal, management 356–9, 550
 hypothesis 343
 mitochondrial oxidation defects 346
 metabolism of colonic epithelial cells 344–6, 549–50
 quiescent v. acute ulcerative colitis 342
 SCFA administration 463–4
see also Colonic epithelial cells
- Ungulates, SCFA concentrations in hindgut 79
- Uptake of SCFA, from colon 444–6
- Ureagenesis
 SCFA effects compared 180
 SCFA in human colon 459
- Urokinase, secretion, colon cancer cells 328
- Ussing chamber 158
- Vagal receptors
 reticulum and rumen 196–7
see also Enteric nervous system

Index

575

- n*-Valerate
 - colonic effects 211–13
 - colorectal cancer 379
- Vascular supply *see* Intestinal blood circulation
- Veillonella parvula*, properties 60, 65, 69
- Very low-density lipoproteins (VLDL), secretion by hepatocytes 495–6
- Vitamin (hormone) D₃, *n*-butyrate, modulation of effects 281
- VLDL *see* Very low-density lipoproteins (VLDL)
- Wallaby, stomach, SCFA production 126–8
- Weaning, physiological change in ruminants 290–2
- Wombat, colonic SCFA production 129
- Xylan
 - breakdown in rumen 62, 88
 - energy as acetate, propionate and *n*-butyrate 442