RICHARD O. KELLEMS D.C. CHURCH





LIVESTOCK FEEDS AND FEEDING

SIXTH EDITION

contents

Preface vii Contributors viii

part one introduction 1

Livestock Feeding 2

Basis for Successful Feeding of Livestock 3

References 6

2

The Gastrointestinal Tract and Nutrient Utilization 7

Classification of Various Digestive Systems 8
Characteristics and Function of Digestive Tract 9
Avian Species 12

Ruminant Species 12

Relationship between Type of Gastrointestinal Tract and Type of Diet Required 14

Summary 15 References 15

3

Nutrients: Their Metabolism and Feeding Standards 16

Water 16

Carbohydrates 18

Protein 20

Lipids 20

Minerals 24

Vitamins 28

Dietary Energy 29

Feeding Standards 31

Methods for Assessing Nutrient Content of Feeds 35

Summary 37 References 37 part two
Feeds for Livestock 39

4

Feedstuffs 40

Classification of Feedstuffs 40
Estimating Nutritional Value of a Feed 44
Nutrient Content of Major Feedstuff Groups 46
Variability in Feedstuff Composition 46
Other Factors Affecting Feed Quality 48
Feed Manufacturing Terminology 50

Summary 53 References 54

5

High-Energy Feedstuffs 55

Introduction 55

Cereal Grains 55

Relative Feeding Values of Cereal Grains 70

Milling By-Products of Cereal Grains 71

High-Carbohydrate Liquid Feeds 74

Dry By-Product Feeds 77

Roots and Tubers 78

Fats and Oils 80

Garbage 82

Other Energy Sources 82

Summary 82 References 83

6

Supplemental Protein Sources 84

Introduction 84

Protein Sources 85

Plant Protein Sources 86

Millfeed Protein Sources 95

Distillery and Brewery By-Products 96

Other Plant Protein Sources 96

Protein Supplements of Animal Origin 97

Milk Products 99

ĪV

Marine Protein Sources 99

Miscellaneous Protein Sources 100

Nonprotein Nitrogen 101

Liquid Supplements 104

Protein Solubility and Degradability by Microorganisms as Related to Ruminants 108

Summary 112 References 112

/ ROUGHAGES 114

Nature of Roughages 115

Basic Differences in Roughages 115

Factors That Affect Roughage Utilization 115

Pastures and Rangelands 116

Chemical Composition of Herbage 119

Factors Affecting Forage Nutritive Value 123

Permanent Pastures and Rangeland 128

Hay and Silage Making 130

Assessment of Nutritive Value of Hays 136

Nutritive Properties of Silages 145

Silage Additives 153

Crop Residues 154

Summary 158 References 158

8

Mineral and Vitamin Supplements 160

Mineral Supplements 160

Variation in Content and Utilization of Minerals in Natural Feedstuffs 167

Vitamin Sources 169

Summary 172 References 172

9

Feed Additives 173

Introduction 173

Use of Feed Additives Classed as Drugs 174

Summary 187 References 187

10

Feed Laws and Labeling 188

Labeling Regulations 189

Medicated Feeds 190

Summary 191 References 192

1 1

Feed Processing 193

Introduction 193

Grain-Processing Methods 194

Roughage Processing 199

Effect of Processing on Nutritive Value 201

Feed Processing for Nonruminant Species 202

Grain Processing for Beef Cattle 204

Roughage Processing for Beef Cattle 206

Feed Processing for Dairy Cows 207

Feed Processing for Sheep and Goats 207

High-Moisture Grain 209

Economics of Feed Processing and Grain Preservation 212

Effect of Processing on Density 212

Oxidized Feed 214

Summary 214 References 215

12

Ration Formulation 217

Introduction 217

Ration-Balancing Process 217

Nutritional Goals and Sources of Information 218

Feed Composition Values 219

Feed Formulas and Conversions 219

Simple Ration Balancing 220

Companion Animals 222

Calculating Appropriate Level of Feed Nutrients 223

Ration Evaluation—Worksheet Methods 224

Balancing Rations Using Computer Programs and Comprehensive Models 234

Ration Formulation in the Future 238

Case Study 239

New Developments 240

Summary 240 References 241

part three Livestock Species 243

13

Feeding Swine 244

Introduction 244

Nutrients Required by Swine 245

Feedstuffs Used in Swine Diets 255

Processing Feeds 269

Feeding Management 270

Summary 284 References 284

14

Feeding Poultry 285

Introduction 285

Nutrient Requirements 285

Classes of Ration Components 287

Feedstuffs for Poultry 291

Feeding Management of Poultry 293

Summary 304 References 305

15

Feeding Dairy Cows 306

Introduction 306

The Lactation and Gestation Cycle 307

A Phase Feeding Program 308

Special Nutrient Considerations 313

Optimizing Feed Intake during Lactation 320

Feeding Groups 321

Example Rations 321

Summary 322 References 322

16

Feeding Dairy Calves and Replacement Heifers 323

Introduction 323

The First Critical Days 323

The First 60 Days 324

Milk Replacer 324

Starter Rations 327

Heifers: Weaning to Breeding 328

Gestation 331

Feeding Dairy Breed Steers

for Beef 332

Cost of Raising Heifers 334

Biosecurity of Dairy Calves 334

References 334

17

Feeding the Beef Cow Herd 335

Introduction 335

Biological Cycle and

Requirements 335

Forages for Beef Cattle 341

Grazing Management 342

Grazing Systems 344

Animal Requirements, Forage Resources,

and Costs 345

Nutritional Management 345

Nutritional Disorders 350

Summary 353 References 353

18

Feeding Growing-Finishing Beef Cattle 354

Introduction 354

Cattle Types and Cattle Growth 355

Systems Used for Growing and Finishing Beef Cattle 358

Managing Newly Received Cattle 361

Starting Cattle on Feed 364

Feed Bunk Management 365

Finishing Diets 365

Anabolic Agents and Feed Additives 369

Metabolic Disorders 371

Summary 372

References 373

part four

Feeding Other Domesticated Species 377

19

Feeding Horses 378

The Digestive System 378

Nutrient Requirements 379

Feeds 383

Feeding Guidelines 390

Common Feed-Related Problems in Horses 395

Feeding Management 395

References 396

20

Sheep Nutrition 398

Introduction 398

Nutrient Needs 399

Body Condition Scoring 404

Ewe Nutrition 406

Lamb Nutrition 413

Growing and Finishing of Lambs 416

Potential Nutritional Problems 419

Feed Processing 420

Nutritional Management of Replacement Ewes 420

Range Ewe Nutrition 422

Nutrition and Wool Production 422

References 424

21

Goats and Goat Nutrition 426

Introduction 426

Feeding Behavior 427

Productivity of Goats 429

Nutritive Requirements 433

Feeding and Management 441

Feeding Goats According to Requirements 443

Common Nutritional Disorders 451

Summary 452 References 453

22

Feeding and Nutrition of Companion and Zoological Species 456

Introduction 456

Nutrients 460

Obesity Issues 461

Other Dietary Problems 462

Commercial Pet Food 462

Pet Food Labels 464

Other Approaches to Feeding the Dog and Cat 466

Other Dog and Cat Food Ingredients 467

Feeding Dogs 470

Feeding Cats 472

Other Companion Animal Diets 473

Birds 478

Reptiles and Amphibians 477

Zoological Diets 483

Summary 486 References 486

23

Feeding Rabbits 488

Introduction 488

Characteristics of Commercial Rabbit Meat

Production 488

Digestive System 489

Digestive Process 489

Feeding Behavior 491

Nutrient Requirements 492

Feedstuffs for Rabbits 499

Feeding Management 500

Practical Feeding 503

Health Problems 505

Feed Conversion 505

Summary 506

References 506

Appendix Tables 509

Glossary 699

Index 705