Contents

Ack		dgments on	vii xiix	
1	Overview of the aquaculture feed industry			
	Zuridah Merican and Dagoberto Sanchez			
	1.	Aquafeed in Asia	1	
	1.1	Introduction	1	
	1.2	A shift in equilibrium	2	
	1.3	Lower demand with EMS	2	
	1.4	Horizontal expansion and integration	2 2 3 3	
	1.5	Extruded and functional feeds		
	1.6	Rising production costs	4	
	1.7	Feed production and trends	4	
	1.8	New capacity and new entrants	6	
	1.9	Shrimp feed types	6	
		Feed prices	7	
	1.11	Country developments	8	
	2.	Aquafeed in the Americas	15	
	2.1	Development of aquafeed production in the Americas	15	
	2.2	Country development	16	
		owledgments	18	
	References		18	
2	Feed formulation software			
		tor Suresh		
	2.1	Introduction	21	
	2.2	The state of the s	21	
		LP-based feed formulation	22	
	2.4		23	
	2.5	•	27	
	2.6	Conclusion	31	
	Acknowledgments		31	
	Refer	ences	31	
3	Understanding the nutritional and biological constraints of ingredients to optimize their application in aquaculture feeds Brett Glencross			
	3.1	Introduction	33	
	3.2	Characterizing ingredients	34	

	3.3	Chemical composition of oils	43
	3.4	Digestibility, palatability, and utilization value of plant	
		protein meals	44
	3.5	Nutritional value of plant and animal oils to aquaculture species	64
	3.6	Processing effects of ingredients	67
	Refe	rences	69
4	Nutr	ient requirements	75
	Césa	r Molina-Poveda	
	4.1	Introduction	75
	4.2	Proteins and amino acids	75
	4.3	Lipids and fatty acids	89
	4.4	Carbohydrates	104
	4.5	Nutritional energetics	116
	4.6	Vitamins	126
	4.7	Minerals	144
	Refe	rences	164
5	Func	ctional feed additives in aquaculture feeds	217
	Pedro	o Encarnação	
	5.1	Introduction	217
	5.2	Phytogenics	218
	5.3	Organic acids	220
	5.4	Yeast products	223
	5.5	Probiotics	226
	5.6	Enzymes	228
	5.7	Mycotoxin binders	230
	Refe	rences	231
6	Opti	mizing nutritional quality of aquafeeds	239
	Karthik Masagounder, Sheila Ramos, Ingolf Reimann and		
	Giris	h Channarayapatna	
	6.1	Introduction	239
	6.2	Sources of nutrient database	240
	6.3	Nutrient levels and variability in commonly used raw materials	244
	6.4	Impact of heat damage on the amino acid level and their variability	253
	6.5	Proximate nutrients of raw material	254
	6.6	Managing nutrient variation	256
	6.7	Integration of Laboratory Information Management System	230
	0.7	and formulation	261
	6.8	Summary	263
		rences	263
	Neie	iciices	265
Ind	ndex		