COMMON AQUATIC INGREDIENT NUTRIENT ANALYSES: BALANCING PRACTICAL FEEDING WITH LONG TERM AQUATIC HEALTH

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Abstract

Optimizing dietary formulations for aquatic species is one of the most challenging aspects of nutrition for exotics. Whether designing diets for elasmobranches, fish in a multi-species aquarium, or marine mammals, understanding the nutrients provided in the food is essential. Ideally, designing aquatic diets utilizes both known body weights of the target species, and analyzed nutrient contents of diet items. Repercussions of overfeeding in an aquatic system can lead to water quality issues, and ultimately poorly understood compromised health in the occupants. While aquatic diets historically have been designed primarily based on energy needs, vitamins and mineral content should also be considered, especially for long term health.

Working with the aquarists at EPCOT, Disney's Animal Kingdom nutrition team conducts regular quality control sampling and compositional analysis to monitor nutrients in a variety of ingredients used for aquatic species (Table 1). We utilize Dairy One laboratories for proximate and trace mineral analysis, as well as our own laboratory for gross energy by bomb calorimetry.

For obesity sensitive species such as the bottlenose dolphin, turtles and black-blotched ray, diet adjustments based on caloric and dietary item intake paired with corresponding body weight data, body condition scoring, and blood draws are actively ongoing. The practical priority of aquarists is often feeding of energy, especially in target fed animals such as turtles and rays, where individual preferences on feed type may change over time. There are marked differences in nutrient content when dietary items are altered (decreased, increased, or removed). Changes in preference leading to changes in consumption will impact health; therefore interaction between teams is essential. The nutritionist provides an understanding of ingredient composition and supplement needs based on dietary ingredient consumption by the animals. For example, dietary calcium concentrations would decrease with use of de-shelled vs. shelled shrimp, de-penned vs. penned squid, or capelin with heads and tails removed vs. whole capelin. Also to be considered is the need for vitamin supplementation (primarily vitamin E), as almost 100% of the aquatic items sampled below are kept frozen and contain very low amounts of vitamin E once thawed (Crissey and Spencer, 1998; DAK quality control database). While much continues to be elucidated on understanding normals for aquatic species, in terms of serum, water, and requirements, knowing exactly what is provided through daily nutrition is a comparably simple piece of the puzzle to track. Information on daily ingredient amounts and corresponding nutrient information will continue to add to the understanding of the effect of diet on long term aquatic animal health.

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Literature Cited
Crissey, SD and Spencer SB (1998) Handling fish fed to fish-eating animals: a manual of standard operating procedures. AWIC.

Table 1. Nutrient Composition on Dry Matter basis of Feeds used in aquatic species diets

	DM	CP	Crude Fat	Ca	P	Mg	Fe	Zn	Cu	Mn	Mo	S	Se	Co	Gross Energy
Unit	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	cal/g
Clam, tongues	25.0	62.9	1.4	0.05	0.46	0.09	102	40	3	3	2.5	1.2	0.99	0.61	4961
Fish, Bonita steak	29.8	81.5	13.7	0.26	0.98	0.11	114	30	5	1	0.0	0.9	6.32	0.14	5972
Fish, Capelin, No heads / tails	20.4	74.3	18.5	1.35	1.60	0.14	262	60	3	10	0.0	0.9	1.35	0.19	5829
Fish, Capelin, whole (avg last 10 in 2014-2015)	19.0	75.6	16.5	1.76	1.91	0.16	92	71	3	4	0.1	1.0	1.52	0.15	5796
Fish, Glass Minnows	20.3	84.3	7.5	3.35	2.28	0.20	40	141	1	10	0.0	1.1	1.91	0.53	4777
Fish, Herring, whole (avg last 10 in 2014-2015)	29.9	54.8	37.0	1.51	1.45	0.13	69	60	3	4	0.1	0.7	2.15	0.12	6630
Fish, Lake Smelt, whole, avg	17.6	75.2	17.1	1.93	1.66	0.12	30	100	2	8	0.1	0.9	1.71	0.08	5727
Fish, Mackerel, whole, avg	27.3	79.2	11.0	1.43	1.68	0.16	114	47	5	2	0.2	1.0	4.17	0.21	5562
Fish, Sardine, whole	45.7	36.6	61.0	0.80	0.87	0.07	62	43	2	3	0.2	0.5	1.79	0.57	7418
Fish, Silversides, whole	26.1	59.1	27.1	2.04	1.75	0.18	34	93	2	5	0.3	1.0	1.73	0.10	6046
Fish, Trout, Idaho Rainbow	26.2	61.3	30.5	2.10	1.83	0.10	105	138	4	3	0.2	0.8	1.20	0.08	6180
Fish, Tuna, trimmed	25.5	98.8	1.2	0.03	1.07	0.12	49	14	2	0	0.1	0.9	6.11	0.09	5391
Gel, Mazuri 5AB0 Aquatic	22.6	64.0	16.7	2.15	1.54	0.14	367	312	19	110	0.3	0.7	1.21	4.99	5364
Krill, Pacifica	16.9	79.7	6.5	1.98	1.51	0.46	36	93	66	4	0.2	1.7	4.97	0.21	5374
Krill, Superba	21.0	61.7	19.8	1.41	1.52	0.36	30	44	84	2	0.2	1.7	1.54	0.17	5978
Prawn, no head, tail, or skin	22.2	94.7	3.5	0.35	1.36	0.21	91	68	25	3	0.1	1.3	2.08	0.14	5495
Prawn, whole	23.6	89.0	5.1	1.08	1.32	0.22	147	68	40	5	0.0	1.1	2.13	0.38	5144
Shrimp, Mysid, whole, avg	18.1	68.2	24.7	1.52	1.20	0.14	48	73	30	7	0.3	0.9	3.93	0.19	5956
Shrimp, White, no heads/ tails	22.3	85.4	3.5	0.74	1.17	0.16	105	49	23	14	0.0	0.8	1.21	0.15	5234
Shrimp, White, whole	19.7	88.4	4.1	0.37	0.80	0.14	65	52	11	7	0.2	1.1	1.35	0.19	5436
Squid, De-penned	18.9	85.1	4.5	0.08	1.35	0.21	9	71	105	2	0.0	1.5	2.98	0.06	5400
Squid, Humboldt	25.4	73.7	21.2	0.06	1.19	0.20	32	71	56	2	0.2	1.5	5.02	0.27	6156
Squid, whole (avg last 10 in 2014-2015)	18.9	80.5	6.7	0.13	1.12	0.25	16	81	183	5	0.1	1.9	3.47	0.22	5458