Research Note

THE USE OF SEAWEED (ALGAE) IN ANIMAL DIETS[1]

Puerto Rico, whose productive agricultural land is limited, is surrounded by the sea. Urban expansion and industrialization projects are diminishing the amount of available agricultural land at an accelerated rate.

In an effort to develop new sources of food for animals, and indirectly for humans, we evaluated seaweed growing in the ocean surrounding Puerto Rico. Algae, both those from the sea and those grown in and harvested from sewage fermentation, are excellent known sources of macro and micro elements, vitamins, antibiotic activity and pigments, and good sources of protein and other nutrients. Some species are used also as a major vegetable in Japan, Europe and North America.

Algae are harvested in considerable amounts for animal and human consumption in countries such as the USA (California), Ireland, Norway and Scotland. In the algae producing countries there is a marked difference between high and low tides; the resulting conditions of shallow waters and uniform bottom for long stretches of coast are optimum for the production and harvesting of algae, which become exposed at low tides. Since Puerto Rican tidal differences are minimal, the problem of harvesting algae must be solved before algae production becomes a commercially profitable enterprise. There is a possibility of artificially harvesting the most promising sea species and those varieties that grow well in sewage. This technology will require further studies.

Algae are classified as plants because they have chlorophyll. The phyla of algae are split between two kingdoms, Monera and Protista. For practical purpose they are further divided according to pigment into flame colored, yellowish, brown, green, brown and blue-green.

The brown algae have a brown pigment in addition to chlorophyll. They are large and mostly marine; they can be seen attached to the rocks along the seacoast. A common genus, Sargassum, forms great masses of seaweed floating along the Puerto Rican coasts; when strong winds churn the waters, the plants are scattered and are deposited on the beaches.

A screening-type study was initiated in cooperation with the Department of Marine Sciences, Mayagüez Campus, to evaluate the most common species growing in the sea surrounding Puerto Rico. Maximum protein and minimum mineral—particularly calcium—contents were used

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TABLE 1.—*Chemical composition (dried basis) of 24 of the most common algae growing in the coasts of Puerto Rico*

Scientific name	Group	Protein content	Mineral content	Ca	P	NaCl
	Color	%	%	%	%	%
Dictyopteris deliculata	Brown	11.88	38.26			1.02
Gracilaria verrucosa	Red	10.63	26.88			1.13
Galaxaura marginata	Red	9.69	42.34			0.92
Gracilaria damae cornis	Red	9.38	36.85			1.18
Codium isthmocladum[1]	Green	9.13	52.21	4.00		0.83
Amansia multifida	Red	7.81	38.33			
Dictyopteris justii	Brown	7.81	33.16			
Dictyota dentata	Brown	7.50	35.54			
Stypopodium zonale	Brown	6.41	32.36			
Chondria littoralis	Red	6.25	37.57			
Hypnea musciformis	Red	6.25	39.99			
Bryothamnion triquetum[1]	Red	6.19	48.50	15.32		0.99
Gracilaria domingensis	Red	5.94	30.51			
Caulerpa racemosa	Green	5.94	53.63			
Galaxaura cylindrica	Red	5.63	45.44			
Pocockiella variegata	Brown	5.63	23.72			
Sargassum lendigernum[1]	Brown	5.50	39.22	8.82	0.08	1.13
Ulva lactuca	Green	5.31	38.95			
Agardhiella ramosissima	Red	5.19	23.09			
Padina gymnospora	Brown	4.84	43.60			
Colpomenia sinuosa	Brown	4.84	59.50			
Gracilaria mammillaris	Red	4.84	37.74			
Halymenia floresia[2]	Red	4.53	35.15			
Laurencia poitei[2]	Red	4.06	48.33			

[1] Used in the chick bioassay.
[2] Deep water algae.

TABLE 2.—*Rate of gain and utilization of feed by birds receiving balanced diets containing 5 to 10% dried algae*

Algae (color)	Percent in diet	Net gain kg	Net gain (lb)	Feed consumed/ liveweight gained
Broilers—Vantress Strain—Rio Piedras Center				
	5	0.95	(2.10)	2.18
Bryothamnion triquetum (red)	10	0.95	(2.10)	2.18
Sargassum lendigernum (brown)	5	0.97	(2.13)	2.51
	10	1.03	(2.27)	2.60
Codium isthmocladum (green)	5	0.98	(2.15)	2.35
	10	0.98	(2.15)	2.43
Pullets—Dekalb Strain—Lajas Substation				
Commercial concentrate (control)		0.76	(1.67)	Not available
Bryothamnion triquetum (red)	5	0.84	(1.84)	Not available
	10	0.91	(2.00)	Not available
Sargassum lendigernum (brown)	5	0.88	(1.94)	Not available
	10	0.89	(1.96)	Not available

as comparison criteria for the use of the dried algae meal in poultry diets with a high (20%) protein and low calcium content (no more than 1%).

Samples of 24 botanically pure species were collected and classified by the co-author at the La Parguera Marine Sciences Laboratories. They were air dried, and further dried in a vacuum oven, and ground. They were then analyzed for nitrogen and ash content. More detailed analyses, including calcium, phosphorus and salt content, were performed on the three samples of the most promising species.

Table 1 shows descriptive and analytical data of the 24 species evaluated. The values show a marked variability among species, and a consistent high total mineral content, which constitutes a limitation for its incorporation at high levels in farm animal diets. The high (over 1%) common salt content of dried marine algae meal is not disadvantageous, but rather an asset, as long as its average content is considered when formulating the diet. The fact that only a few green species were considered common and evaluated is also worth mentioning.

A comparison of three of the most promising species, with a chick bioassay, was conducted simultaneously at Río Piedras and at the Lajas Substation, with birds of a broiler and a laying strain. A comparison was made of nutritionally adequate diets containing 0 and 5% of the most promising dried algae of the red, brown, and green groups. Table 2 shows that locally produced marine algae may be efficiently used at low levels (5%) in nutritionally balanced diets for birds. Clarification of maximum and optimum levels of components in different farm animal diets, demands further studies.

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