Dietary fillers reduce growth and affect apparent digestibilities of pink snapper

S.A. Saxby[1,2], I.H. Williams[1] and B.D. Glencross[2]

[1] Animal Science Group, University of Western Australia, Nedlands, Perth WA 6907
[2] Fisheries WA, Mariculture Research and Advisory Group, P.O. Box 20, North Beach WA 6020
sidsaxby@cyllene.uwa.edu.au

Fillers are included in small amounts (2 – 4%) in finfish diets as bulking, binding, and buffering agents. They are also used in larger amounts to formulate negative controls in summit dilution experiments (Williams *et al.* 1997) where they often substitute for a test ingredient to levels of 40% or more. Fillers are assumed to be nutritionally 'inert', but at such high inclusions, it is difficult to suppose they have no effect. We tested three commonly used fillers, calcium bentonite, α–cellulose and diatomaceous earth (each at 40% in a diet of 50% fishmeal, 20% wheat gluten and 20% wheat flour) and measured total food intake (TFI), feed intake on the day of the gut transit study (GTFI), growth (SGR), feed conversion (FCR), time for initial (IE) and peak egestion (PE) of gut contents, and apparent digestibilities of protein, lipid, phosphorus, organic matter and energy. More gluten (+5%) was needed in the diatomaceous earth diet to stabilise pellets, increasing apparent digestibilities of this diet above those of the control diet. Snapper (*Pagrus auratus*) were fed to apparent satiety once daily for 25 days. Sedimented faeces, containing chromic oxide marker, were collected hourly for 23 hours in the gut transit study and then once daily. Fillers changed all dietary parameters except initial egestion times ($P<0.05$) (see Table). Cellulose and diatomaceous earth in the diet reduced feed intake and, accordingly, specific growth rates. Snapper rejected the diatomaceous earth diet, while only bulk in the cellulose diet prevented them consuming similar weights to the other, more dense diets. Growth rates from the bentonite diet were slightly better than those of cellulose, but with the weight of bentonite diet consumed more than double that of cellulose, much higher bentonite food conversion ratios were evident. Although cellulose and bentonite diets were formulated to be nutritionally equivalent, these results suggest a loss of nutritional value from the bentonite diet. The fish lost weight on the diatomaceous earth diet. Despite large differences in intakes on the day of the gut transit trial, faeces were egested after a similar time. More rapid peak egestion of cellulose diets may indicate some acceleration of digesta by this filler. Apparent digestibilities of protein, lipid and P were not significantly altered by diatomaceous earth and cellulose but all were decreased by bentonite, particularly protein and P. This is consistent with bentonite's adsorptive properties, used to separate phosphate from wastewater and cloudy proteins from wine. Diatomaceous earth was the least nutritionally active filler but was rejected due to its effects upon intake. Cellulose was selected because its effects on digestibility were minimal.

Williams, K.C., Allan, G.L., Smith, D.C. and Barlow, G.C. (1997). Fishmeal replacement in aquaculture diets using rendered protein meals. Paper presented at: 4th International Symposium, ARA, Inc., *Animal Nutrition, Protein, Fats and the Environment,* St Kilda, Melbourne, Australia.

	Performance (± SE)						**Apparent digestibility (%) (± SE)**				
Diet	**TFI (g/kg fish)**	**SGR (% bw/d)**	**FCR (g/g)**	**IE (h)**	**PE (h)**	**GTFI (g)**	**Protein**	**Lipid**	**Phosphorus**	**Organic matter**	**Energy**
Control	240^{c}	0.93^{d}	1.02^{b}	10.1^{a}	18^{b}	15.4^{c}	90.0^{b}	91.8^{b}	30.4^{bc}	83.3^{b}	91.3^{b}
	(19)	(0.07)	(0.11)	(2.3)	(0.7)	(0.7)	(0.41)	(1.03)	(2.29)	(0.54)	(0.55)
Bentonite	280^{c}	0.29^{c}	3.97^{d}	12.5^{a}	20^{b}	20.0^{d}	73.2^{a}	81.6^{a}	-44.9^{a}	47.7^{a}	81.9^{ab}
	(10)	(0.04)	(0.63)	(1.0)	(0.3)	(0.6)	(1.40)	(2.04)	(7.61)	(3.13)	(6.35)
α–Cellulose	120^{b}	0.18^{b}	2.92^{c}	10^{a}	15^{a}	9.4^{b}	88.6^{b}	86.0^{ab}	12.31^{b}	49.3^{a}	62.9^{a}
	(12)	(0.03)	(0.55)	(1.2)	(0.7)	(1.9)	(0.51)	(2.86)	(1.56)	(0.77)	(0.56)
Diatomaceous	54^{a}	-0.38^{a}	-1.32^{a}	13.8^{a}	19^{b}	3.5^{a}	90.7^{b}	84.6^{ab}	41.3^{c}	80.6^{b}	94.5^{b}
Earth	(4)	(0.03)	(0.15)	(1.3)	(0.3)	(1.0)	(0.75)	(2.30)	(5.85)	(1.72)	(2.79)

Within columns, means with different superscripts are significantly different ($P<0.05$, Tukey Kramer HSD) (n = 3)