

## The Effect of Kelp *Ecklonia maxima* Inclusion in Formulated Feed on Growth, Feed Utilization and the Gut Microbiota of South African Abalone *Haliotis Midiae*

**Authors :** Aldi Nel, Cliff L. W. Jones, Justin O. G. Kemp, Peter J. Britz

**Abstract :** Kelp *Ecklonia maxima* is included in formulated abalone feeds in South Africa, but its effect on abalone growth, feed utilisation efficiency and gut-bacterial communities has not previously been investigated. An eight-month on-farm growth trial with sub-adult *Haliotis midiae* (~43 mm shell length) fed graded levels of kelp in formulated feeds was conducted. Kelp inclusion (0.44-3.54 % of pellet dry mass) promoted faster growth (65.7 - 74.5 % total mass gain), with better feed and protein conversions (FCR: 1.4 - 1.8; PER 2.3 - 2.7), compared to abalone fed the non-supplemented feed (52.3% total mass gain; FCR: 2.1; PER 1.9;  $p < 0.001$ ). The gut-bacterial communities of abalone fed kelp-supplemented feed (0.88 % of pellet dry mass) were subsequently compared with that of abalone fed a non-supplemented control diet. Abalone gut-bacterial DNA was sequenced using 16S rRNA pyrosequencing and sequences were clustered into operational taxonomic units (OTUs) at a 97 % similarity level. A supplementary 16S rRNA denaturing gradient gel electrophoresis (DGGE) analysis was conducted. The dominant OTUs differed in terms of their relative abundances, with that of an autochthonous Mollicutes strain being significantly higher ( $p = 0.03$ ) in the guts of abalone fed kelp-supplemented feed. The DGGE band patterns displayed a higher within-group variability of dominant bacterial strains for abalone fed the control diet, suggesting that dietary inclusion of kelp, which is rich in fermentable polysaccharides, promotes a balanced gut-bacterial community. This may contribute to the better feed utilisation and growth in abalone fed kelp-supplemented feeds.

**Keywords :** abfeed, digestion, macroalgae, mariculture

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