The production of highly unsaturated fatty acids using agro-processing by-products.

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Figure 1: White stumpnose (*Rhabdosargus globiceps*) – one of the fish species fed on feeds containing processing by-products

ABSTRACT:
The South African agro-processing industry generates millions of tons of cereal derived by-products annually. The by-products from biofuel production are expected to increase these volumes dramatically.

Highly unsaturated fatty acids (HUFA) such as eicosapentaenoic acid (EPA) are essential to regulate the immune, cardiovascular, digestive and neurological systems in mammals. These fatty acids have to be included in mammal and fish diets[1]. The main dietary source of HUFA is marine fish oil, but there are concerns over the sustainability of fish sources as demand for crude fish oil for the aquaculture industry increases[2].

Recent research has focused on fungal production of HUFA as a sustainable and safe alternative to fish oil[3]. Oleaginous fungi of the genus *Mortierella* are used for industrial production of some of these valuable HUFA.

This research utilised agro-processing by-products (brewers' spent grain, soya oilcake and sunflower press cake) as fungal growth substrates for the production of HUFA.

Figure 2: *Mortierella* fungal biomass containing fungal oils added to brewers' spent grain to produce fish feed

The HUFA-enriched cereal by-products (Fig 2) were incorporated into fish feed for white stumpnose (Fig 1) and dusky cob. Feeding trials with juvenile cob indicated that fish performance on this diet was comparable to that on control fish feed containing fish oil.

Figure 3: Examples of the feed pellets produced with brewers' spent grain for the juvenile fish feeding trial.

METHODOLOGY:
Mortierella species were grown on the solid cereal by-products such as sunflower press cake. Ten percent (m/m) linseed oil (containing the EPA precursor, α-linolenic acid) was added to half of the substrate treatments. The levels of EPA and other HUFA in the fermented biomass were then determined by gas chromatography with flame ionisation detection.

RESULTS AND DISCUSSION:
The target concentration of total HUFA required in marine fish diets is generally accepted as ~1% m/m omega-3 HUFA, depending on fish species.

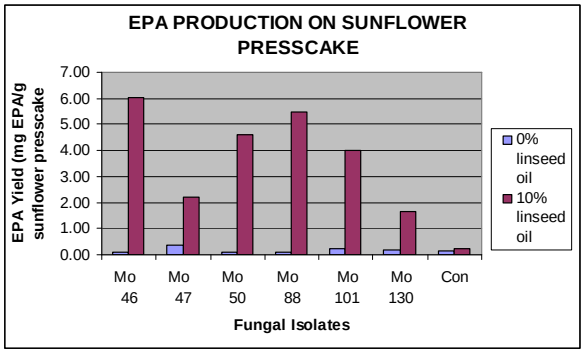

Figure 4: The production of EPA on sunflower press cake by fermentation with *Mortierella* fungi

EPA production by the *Mortierella* isolates tested was improved by the addition of linseed oil, which contains the EPA precursor, to the substrate. The highest yield of 0.6% (m/m) EPA in the sunflower substrate was achieved with *Mortierella alpina* Mo 46 (Fig. 4).

CONCLUSION:
Fermentation with oleaginous fungi of the genus *Mortierella* produced HUFA-enriched cereal by-products with a potential application as fish feed in the local aquaculture industry.

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