Introduction

Plant-derived feedstuffs constitute a less expensive and more sustainable alternative to fishmeal in fish feeds formula. However, the presence of anti-nutritional factors within these ingredients is probably the major constraint to their use.

Anti-nutrients are substances which directly, or through their metabolic products, interfere with nutrient assimilation. They can either be endogenous or adventitious factors occurring during feed storage and processing.

Anti-nutritional factors can be classified regarding their chemical description, their biological effects, or their ability to withstand heat treatments:

1. **Chemical description** (Tacon, 1985)
   a. Proteins
      - Protease inhibitors
      - Haemagglutinins (lectins)
   b. Glycosides
      - Glucosinolates
      - Cyanogens
      - Saponins
      - Estrogenic factors
   c. Phenol
      - Gossypol
      - Tannins
   d. Miscellaneous
      - Anti-minerals
      - Anti-vitamins
      - Anti-enzymes
      - Toxic amino acids
      - Mycotoxins

2. **Biological effects** (Francis et al., 2001)
   e. Factors affecting protein utilisation and digestion
      - Protease inhibitors
      - Tannins
      - Haemagglutinins (lectins)
   f. Factors affecting mineral utilisation
      - Phytic acid
      - Gossypol
      - Glucosinolates
   g. Antivitamins
   h. Miscellaneous
      - Mimosine
      - Cyanogens
      - Estrogenic factors

3. **Heat resistance** (Francis et al., 2001)
   i. Heat labile factors
      Protease inhibitors, phytic acid, haemagglutinins, glucosinolates, and anti-vitamins.
   j. Heat stable factors
      Saponins, non-starch polysaccharides, anti-genic proteins, estrogens, and some phenolic compounds.

For a review of studies where plant-derived ingredients were used, please refer to Tacon (1997) and Francis et al. (2001).