ALGAL BINDER

A natural source of alginic acid

Replacement for urea - formaldehyde

DISADVANTAGES OF UREA-FORMALDEHYDE

The inclusion of a synthetic binder improves water stability and reduces leaching. This would result in a lower FCR. But at the same time, this binder links to proteins and reduces its digestibility. This reduction in protein digestibility results in a slightly slower growth.

Urea-formaldehyde is a synthetic binder with no nutritional value. It cannot be digested by fish or shrimp, instead it adds nitrogen (false protein) to the diet which ends up like ammonia in the ponds. In the process, formaldehyde is bound to the NH_2 group of Urea to form a polymer.

However, the formaldehyde can also bind to other amine (NH_2) groups in other products such as melamine or amino acids. Formaldehyde is a cross-linking agent to inactivate, stabilize or immobilize proteins. Formaldehyde was shown to react with the amino group of the N-terminal amino acid residue and the side-chains of arginine, cysteine, histidine, lysine residues.

Therefore, it is advisable to use nutritional binders, with a high protein digestibility (De *Muylder et al*., 2008).

ADVANTAGES OF SEAWEED CONCENTRATE

Brown seaweeds are rich in minerals (14–35% DM) and contain low to moderate amounts of crude protein (7–13% for *M. pyrifera*). Cell walls are made of cellulose and **alginic acid**, a long-chained heteropolysaccharide that is present in large quantities (20–27% for *M. pyrifera*) (Rodríguez-Montesinos and Hernández-Carmonal, 1991; Guiry, 2014).

Seaweeds contain a number of complex carbohydrates and polysaccharides. Brown algae contain **alginates**, sulphated **fucose**-containing polymers and **laminarin**. The cell walls of several of brown seaweeds, particularly of Fucales and Laminariales, consist mainly of **fucoidans**, which are composed of variable amounts of saccharide units with different degree of sulphation (Mišurcová, 2012). The principal carbohydrate reserve in brown seaweeds is laminarin (also called laminaran), a polysaccharide of glucose, unlike other seaweeds in which starch is the storage carbohydrate. The brown colour results from the dominance of the xanthophyll pigment **fucoxanthin**, which masks the chlorophylls, beta-carotene and other xanthophylls (Guiry, 2014).

Brown seaweed **lipids** are rich in functional omega-3 PUFAs such as EPA (20:5n−3) and SDA (18:4n−3). **Fucoxanthin**, a characteristic carotenoid found in brown seaweed lipids, shows antiobesity and anti-diabetic effects. Brown seaweed lipids have exceptional high oxidative stability (Miyashita *et al*., 2013).

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Brown seaweeds are rich in **potassium**, **sodium** and particularly **iodine** (Rodríguez-Montesinos and Hernández-Carmonal, 1991; Guiry, 2014). Indeed, Laminaria have the capacity to accumulate iodine by more than 30,000 times the iodine concentration in the seawater (Mišurcová, 2012).

Prebiotic compounds in seaweeds may help to enhance livestock production and health.

Grouper fed a sodium **alginate**-containing diet upregulate anti-stress and immune responses.

Sodium **alginate** administration downregulated stress response indicators, enhanced immune responses, and prevented impacts of physiologic stress responses, immunosuppression, and susceptibility to *P. damselae* subsp. *piscicida* in grouper subjected to cold stress (Pai-Po Lee *et al*., 2017).

Administration of sodium **alginate**, as an immunostimulant, was demonstrated to enhance the immunity and resistance of abalone (Cheng & Yu, 2013), shrimp (Cheng *et al*., 2005), and fish (Yeh *et al*., 2008).

Fucoidan can be used as immunostimulant for the farmed African catfish, *C. gariepinus* as it can improve its resistance to immunosuppressive stressful conditions (El-Boshy *et al*., 2014).

Sodium **alginate** can be used as an immunostimulant for abalone through dietary administration to enhance immune responses of abalone and resistance against *V. parahaemolyticus* (Cheng & Yu, 2013).

Shrimp fed with a **fucoidan** (a polysaccharide extracted from brown seaweed) supplemented diet had enhanced the innate immunity and increased resistance against WSSV (white spot syndrome virus) infection (Immanuel *et al*., 2012).

Oral administration of crude **fucoidan** has been reported to reduce the impact of WSSV in black tiger shrimp *P. monodon*.

Takahashi et al. have observed the ability of **fucoidan** containing meals and extracts to control WSSV in Japanese kuruma shrimp.

Fucoidan effectively provokes the innate immunity of white shrimp *Litopenaeus vannamei* and its resistance against *Vibrio alginolyticus* infection (Kitikiew *et al*., 2013).

Alginate stimulates immune system and up-regulates immune-related genes expression of Pacific white shrimp.

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The supplementation of **alginate** on the diet of *L. vannamei* enhances the innate immunity as well as the expression of immune-related genes (Yudiati *et al*., 2016).

The effect of six different binding agents (agar, **sodium alginate**, cassava starch, gelatin, wheat gluten and kelp meal) in two concentrations (30 g kg−1 and 50 g kg−1) were evaluated with respect to physical quality of *Litopenaeus vannamei* broodstock pelleted feed, after 15, 30, 60, 90, 120, 150 and 180 min of water immersion. The best treatments in terms of water stability, water absorption and protein leaching were obtained with **sodium alginate** at 50 g kg−1 (Argüello- Guevara, 2013).

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