Dietary potassium diformate in fish feeds

By Christian Lückstädt

Preliminary studies on potassium diformate as feed additive in fish feeds show the benefits of dietary organic acids in feeds for tilapia in Asia.

Growing awareness from consumers and producers of aquaculture species has resulted in a demand for responsible and sustainable aquaculture. The regulatory authorities in most exporting countries now focus on the misuse of antibiotic growth promoters (AGP) in aquaculture, while public attention has shifted towards sustainable production methods.

Several feed additives, including acidifiers consisting of organic acids and their salts may be promising alternatives to the use of antibiotics in aquaculture feeds. Acid preservation of fish and fish viscera to produce fish silage has long been a common practice and the final product has been widely used in fish feeds with beneficial effects, such as reduced levels of total volatile nitrogen. This is a key indicator on the freshness of fishmeal. The beneficial effects of acid preserved products have also prompted the scientific community to investigate the effects of applying these short-chain acids directly onto fish feed (Lückstädt, 2008).

In-feed acidifiers are currently applied to temperate and tropical fish species, such as trout (*Oncorhynchus mykiss*), charr (*Salvelinus alpinus*), salmon (*Salmo salar*) and tilapia (*Oreochromis niloticus*), as well as shrimp and abalone. In recent trials, the inclusion of potassium diformate in fish diets was tested in tilapia, *O. niloticus*, under laboratory conditions at the Bogor Agriculture University, Indonesia and at the Chinese Academy of Agricultural Sciences, Beijing, respectively.

Potassium diformate (KDF) in diets for tilapia

In a university trial in Indonesia, 320 male hybrid tilapia were randomly allocated into 4 treatment groups (negative control and 3 acidifier groups, containing 0.2%, 0.3% and 0.5% potassium diformate (KDF), respectively). Fish were fed 6 times a day over an 85-day trial period with a pelleted diet containing 32% protein, 25% carbohydrate and 6% lipids. Beginning on day 10, all fish were orally challenged with *Vibrio anguillarum* (10^5 CFU/day) once a day for 20 days.

Results indicated significant improvements ($P<0.05$) in all treated groups. The 0.2% application of KDF in tilapia led to a significantly increased feed intake (8.6%), weight gain (18.6%) and a significantly improved feed conversion ratio (8.2%). Furthermore, mortality rates due to the *Vibrio* infection were significantly reduced (Table 1).

Table 1. Performance parameters of tilapia challenged with *Vibrio anguillarum* with or without KDF treatment (table modified from Ramli et al. 2005).

Parameter	Control Group	2kg/tonne KDF (0.2%)	3kg/tonne KDF (0.3%)	5kg/tonne KDF (0.5%)
Initial weight (g)	16.7	16.7	16.7	16.7
Final weight (g)	218^{a}	258^{c}	246^{b}	252^{bc}
Feed conversion Ratio (FCR)	1.34^{a}	1.23^{b}	1.25^{b}	1.22^{b}
Percent mortality rate for days 10 to 85	33.0^{a}	20.8^{b}	18.4^{b}	11.0^{c}

^{abc} *Note: values with different superscripts within rows are significantly different ($P<0.05$)*

Similar results were achieved by Zhou et al. (2008) with hybrid tilapia (*O.niloticus* x *O. aureus*). In this study, they used fingerlings (2.7g initial weight) in a dose response study with KDF added at 0%, 0.3%, 0.6%, 0.9% and 1.2% in diets. The response was compared with fish fed an antibiotic growth promoter at 8 mg/kg Flavomycin. During the 56 day trial period, tilapia fed the KDF enriched diets grew faster at up to 11.6% than the negative control (without organic acids). Fish fed 0.3% and 0.6% KDF achieved better weight gain than the fish in the positive control group (Table 2). The authors speculated that dietary KDF could stimulate a beneficial bacterial colonization of the intestine.

Table 2. Effects of dietary KDF on growth performance, feed conversion as well as survival rate of hybrid tilapia (table modified from Zhou et al. 2008).

Parameters	0% KDF	0.3% KDF	0.6% KDF	0.9% KDF	1.2% KDF	8mg AGP
Initial weight (g)	2.7	2.7	2.7	2.7	2.7	2.7
Final weight (g)	9.6	10.5	10.4	10.0	9.7	10.2
Weight gain (%)	262.5	293.1	291.3	275.4	265.4	281.0
SGR (%)	2.30	2.44	2.43	2.36	2.31	2.39
Feed intake (g/d)	0.36	0.36	0.35	0.35	0.35	0.35
FCR	2.91	2.58	2.55	2.69	2.80	2.63
Survival (%)	96.3	95.0	98.8	98.8	100.0	95.0

KDF in fish meal

In another study, the objective was to investigate the effect of potassium diformate (KDF), added during fishmeal production, on growth and FCR in Atlantic salmon (*Salmo salar* L.) under Norwegian conditions.

The trial was carried out at AKVAFORSK research station in Sunndalsøra, Norway. Atlantic salmon with a mean weight of 270g were randomly distributed between 9 fibre glass tanks ($1m^3$), with 50 fish in each tank. The tanks were supplied with 20 litres/min of sea water (30-32â) for a total experimental period of 126 days. The average temperature during the trial was 10°. A 24 h light regime was used throughout the experimental period and the fish were fed continuously with automatic feeders with a commercial fish feed (40% crude protein and 30% fat) containing 0%, 0.8% or 1.4% KDF. The total biomass and the number of fish in each tank were determined at 0, 42, 84 and 126 days (Table 3). Data (mean ± standard deviation) were subjected to statistical analysis and a significance level of 0.05 was used in all tests.

Table 3. Performance of Atlantic salmon fed 3 different test diets for 126 days (Mean ± SD).

Treatment	Initial weight (g)	Final weight (g)	Body weight gain (g)	Specific growth rate SGR	FCR[1)]
0.0% KDF	276.0 ± 5.5	575.0 ± 37.0	299.0 ± 61.3	0.58 ± 0.08	0.83 ± 0.05^{a}
0.8% KDF	275.1 ± 4.8	626.7 ± 14.8	351.6 ± 22.3	0.65 ± 0.02	0.77 ± 0.00^{b}
1.4% KDF	258.6 ± 12.4	615.0 ± 12.9	356.4 ± 33.1	0.69 ± 0.06	0.75 ± 0.01^{b}

[1)] *Means with different superscripts in each row differ significantly ($P\leq0.05$)*

Fish fed pelleted diets containing potassium diformate enriched fishmeal showed increased body weight gain (17% and 19% for 0.8%

and 1.4% KDF inclusion rate respectively). The SGR of fish fed 1.4% KDF tended to be higher (P=0.055) compared to the negative control. Furthermore, both groups treated with KDF had a significantly better feed conversion ratio. It was seen as well, that the uniformity of fish fed KDF treated fishmeal was improved (data from Christiansen and Lückstädt, 2008).

Conclusion

With the results shown above, it may be stated that the use of organic acid salts, such as potassium diformate, in tilapia as well as salmon aquaculture can improve the grow-out period in terms of performance and sustainability. However, more trials to validate these results are suggested.

References

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