# Storage control for fish, offal or by-catch

By Christian Lückstädt

**The use of a blend of potassium diformate, antioxidant and corrosion inhibitor can extend the storage period of raw fish, offal or by-catch worldwide.**

Almost a third of the world fish harvest is not used for direct human consumption, but is converted into fish meal or fish oil for further application in animal feed. About 25 million tonnes of fish for human consumption is processed in ways other than fresh, frozen, smoked or canned (Balios, 2003). The supply of huge volumes of high quality fish meal is necessary to supply the rapid growing aquaculture industry, which is growing at approximately 10% annually (FAO). The amount of high quality fish meal of the total amount of fish meal is expected to grow from 8% to 50% during the next 30 years (Hydro Norway, 2000).

## Acid preservation

Acid preservation of fish and fish viscera to produce fish silage is a common practice and the final product has been widely used in fish feeds with reported beneficial effects (Gildbert and Raa, 1977; Åsgård and Austreng, 1981). It is a widely used method in many European countries to preserve fish-by-products as well as freshly caught "industrial fish" for further fish meal or fish oil production with formic acid or potassium diformate in order to prolong fishing time or to extend the storage duration of those fish.

A special product for this application has been developed by Addcon, the largest producer of formates in the world. Fishform® Plus, a blend of potassium diformate, antioxidant and corrosion inhibitor, was extensively tested to store raw fish, by-catch or offal world-wide. However, the existing storage procedure for fish is currently adjusted to low temperatures of about 5°C. At those temperatures the suitable storage period of fish and fish by-products can be prolonged with the aid of acid-based preservatives to roughly 3 times the normal storing period without preservatives.

There is growing interest in the preservation of fish in the booming aquaculture regions of South East Asia in order to preserve fish waste, by-catch and surplus fish as well. Trials were designed to store fish (sardines) at higher temperatures.

The present study examined the effectiveness of a blend of potassium diformate, antioxidant and corrosion inhibitor (FishForm® Plus) as a preservative of sardines at different elevated temperatures (9.8°C and 15.7°C). The blend was added in 4 different concentrations (0.25%, 0.375%, 0.50% and 0.625%) next to a negative control. Furthermore, an additional treatment level of 0.750% was stored at 15.7°C. At day zero samples of the sardines were taken for Total Volatile Nitrogen (TVN) analysis prior to distribution into the storage containers.

TVN is often used as a criterion for the freshness of fish raw material (Haaland and Njaa, 1987). This value in the fish before processing is known as the most important quality criteria for raw industrial fish. The main constituents of TVN are trimethylamine and ammonia. The amount increases with time of storage in the unfrozen

*Fish for industrial purpose or human consumption*

**Table 1: Time in hours until the 80mg TVN limit per 100 g sardines is reached at different temperatures with or without acid-treatment**

| | Concentration of potassium formate blend (FishForm® Plus) in % | | | | | |
|---|---|---|---|---|---|---|
| Temperature | 0 | 0.25 | 0.375 | 0.5 | 0.625 | 0.75 |
| 9.8°C | 72 | 120 | 144 | 144 | 192 | n.d. |
| 15.7°C | 48 | 48 | 72 | 72 | 120 | 120 |

n.d. – not determined

state. Trimethylamine originates from bacterial decomposition and the presence in fish is therefore taken as an indication for bacterial growth, while the ammonia comes from break down of amino acids – thus reducing the quality of the available protein. Levels of 40 to 80mg TVN per 100g fish mass are regarded by the industry as limits for a good quality fish meal.

## A delay in TVN

At both temperatures the pH levels of the treated sardines were lower than the control. The lowest pH was shown with the highest concentration of preservative. Within treatments, once stabilised there were no significant changes in the pH-level. The overall TVN level at the start of the experiment was 36.2 mg /100g fish. Values in the control increased rapidly and exceeded 80mg after 72 hours at 9.8°C storage temperature, while they reached the same level after 48 hours at 15.7°C.

At both temperatures the fast TVN development was delayed by the addition of the potassium diformate blend. This delay was however dosage dependent. At 9.8°C it took 120 hours to exceed 80 mg TVN per 100g fish material with 0.25%, 144 hours with 0.375% and 0.5%, while it took 192 hours to reach the limit of 80mg TVN if the fish was stored with 0.625% of the potassium diformate blend. Comparable time periods at 15.7°C were 48 h, 72 h, 72 h and 120 h (Table 1).

The results clearly indicate that the addition of a potassium diformate blend result in an extension of the storage period of fish, even under high temperatures. The storage period for sardines added 0.625% potassium diformate blend or higher was 2.5 times longer than that for the control at both temperatures. This was either 8 or 5 days for storage temperatures of around 10°C and 16°C respectively.

In cases where the storage of the trash fish or by-catch is done without any cooling at high temperatures in tropical Asia, it seems necessary to increase the recommended dosage to at least 1%. This seems to be a very important finding, since many fish landing places in rural areas of South East Asia are often lacking appropriate cooling devices or possibilities.

## Enriched fishmeal

Finally, several studies also showed the performance enhancing effects of Fishform® Plus treated fish meal on fish. Such a study for instance was carried out with Atlantic salmon *Salmo salar* (Christiansen and Lückstädt, 2008). Salmon with a mean weight of 270g were randomly distributed between 9 fibreglass tanks (1m$^3$), with 50 fish in each tank. The tanks were supplied with 20 litres/min of sea water (30-32‰) for a total experimental period of 126 days. Fish fed pelleted diets containing Fishform® Plus (potassium diformate - KDF) enriched fishmeal had a numerically 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 (P<0.05). It was seen as well, that the uniformity of fish fed KDF treated fishmeal was improved.

Thus, the inclusion of Fishform® Plus to raw fish is not only to improve the quality of fishmeal, but also leads to better growth performance in fish.

*Literature is available upon request from the author*

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