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CIBA e-Publication series No.18
Fact sheet from CIBA

Fact Sheet on Ethoxyquin Residues in Farmed Shrimp from India

1. Background

On detection of ethoxyquin residues in imported shrimps during August- September 2012, Japan had rejected 19 shipments of farmed Black Tiger shrimps that originated from eastern states of India, West Bengal and Orissa. As a consequence, India's shrimp export to Japan had come under rigorous strain, market prices of shrimps had crashed abruptly, and farmers were not hopeful about taking up shrimp farming. It has been reported that Japan is considering a ban on shrimps from India unless India resolved this issue.

When Japan started regulating the levels of ethoxyquin residue in imported seafood, the first country to suffer due to this enforcement was Vietnam. Vietnamese seem to have complained that they were unfairly treated as other exporters were spared of this regulation. Now the enforcement been expanded to several countries including India. The available scientific information on the use and residual level of the synthetic antioxidant is scanty with reference to shrimp from India or from other parts of the world. Considering the importance of this issue, this fact sheet is prepared and presented as a single comprehensive source of information for better understanding of the issues involved. Through this fact sheet we hope to sensitize different stakeholders of this industry like fish meal producer, feed manufacturer, farmer, shrimp processor, exporter, research scientists and policy makers about the issues of antioxidant residues. Though the furore created by the action of Japan has died down, there is a possibility that this would again surface in another form and at that time we should be better prepared to respond.

2. Antioxidants used in feed

The effective synthetic antioxidants used in feeds and feed ingredients are:
(a) Ethoxyquin (generic term: 1,2-dihydro-6-ethoxy-2,2,4- trimethylquinoline)

(b) BHA (Butylated hydroxyanisole);

(c) BHT (Butylated hydroxytoluene)

(d) Octylgallate
(e) Propylgallate

Ethoxyquin (EQ) is chemically known as 1,2-dihydro-6-ethoxy-2, 2, 4-trimethylquinoline. It is used primarily as an antioxidant preservative in animal feed. It is also used in dehydrated storage of forage crops and as an antiscald agent in fruits. Japan has banned its use in human food due to the reported adverse effects on human health and has fixed different maximum residual limits for different types of food. Among the synthetic antioxidants, Ethoxyquin has been demonstrated to be the most effective, followed closely by BHT and BHA. The U.S. Food and Drug Administration permit 150 ppm of ethoxyquin and 200 ppm of BHT and BHA in finished feed.

Butylated hydroxyanisole (BHA, *tert*-butyl-4-hydroxyanisole) is a synthetic phenolic antioxidant, authorized as a food additive in the European Union for certain food products including cake mixes, cereal-based snack foods and milk powder. Butylated hydroxytoluene (BHT, 2,6-di-tert-

butyl-p-cresol,) is another synthetic phenolic antioxidant authorized as a food additive (individually or in combination with other synthetic antioxidants authorized in food) in the European Union for a range of products including sauces, chewing gum and oils. EQ, BHT and BHA are currently authorized in feed for all animal species with a maximum concentration of 150 ppm feed, alone or in combination with other authorized synthetic antioxidants

3. Response to ban

Consequent to the rejection of shrimp by Japan, fish meal producers, feed manufacturers were sensitized about the residual level of ethoxyquin on shrimp and the alternate strategies to be adopted by Marine Products Development Authority (MPEDA). Instead of ethoxyquin the combination of BHT and BHA is being advocated in fish meal and fish oil. Further to minimise the concentration of ethoxyquin, elimination of gut contents through starving the shrimp for one day was also recommended to farmers.

4. Issues to be addressed in relation Ethoxyquin residues

4.1 Source of Ethoxyquin

The only source for ethoxyquin in farmed shrimps could be the formulated feeds on which shrimps are grown. In the formulated feeds, the sources could be either one or both of the following:

- The fishmeal and/or fish oil added to the feed contains substantial level of ethoxyquin as an antioxidant/stabilizer. International Maritime Organisation (IMO) recommends, inclusion of between 400 and 1000 ppm of ethoxyquin, or of between 1000 and 4000 ppm BHT in fishmeal during production to prevent spontaneous combustion during overseas transport and storage. Therefore accumulation of these antioxidant residuals in fish and shrimp, which were fed on fishmeal, is natural. In this juncture it would be ideal to include ethoxyquin at 150ppm or 200ppm of BHT or BHA in the fish meal produced in India and this concentration would be sufficient to prevent the oxidation as the time lag from fishmeal production to utilisation in feed is significantly shorter in the case of locally produced fishmeal.
- Direct addition of ethoxyquin as antioxidant in shrimp feed production process. Shrimp feeds normally contain only 5-7% fat and therefore do not need extra antioxidants. To our knowledge, many feed manufacturers in India are not adding antioxidants/ or they may be adding very low levels to the shrimp feed, if it is intended for long term storage.

Hence it may be inferred that, ethoxyquin in the shrimp should be mostly coming from the fishmeal and fish oil used in the feed.

4.2 Depuration and effect of Ethoxyquin in culture species

While there were no studies available in establishing the fate of ethoxyquin in shrimps, a study in salmon estimated that the half- life of parent ethoxyquin as 2.5 days. However, 99% of it's alternate metabolic form (ethoxyquin dimer) stayed even after 14 days of depuration. But the toxicity of this dimer form is not known. In Norway, 14 days depuration period prior to slaughtering of farmed salmon is mandatory. Perhaps, with shrimp a finishing diet free of ethoxyquin fed for the last 10 or 15 days might be better. Like India, Vietnam has also advised farmers not to feed shrimp 24 hours before harvest to lower residual ethoxyquin levels. However this recommendation is not backed by specific studies in shrimp. Since Ethoxyquin is a lipid associated chemical, and lipid components have longer half-life in the body and hence the number of days of depuration required

to bring the level needs to be studied. There is no detrimental effect of ethoxyquin to farmed fish at the permitted level of usage in fishmeal/feed. A study conducted in the tiger shrimp with feed containing 500 ppm synthetic anti oxidants showed hepatopancreatic lesions only.

4.3 Japan's ban of shrimp based on Ethoxyquin residues is not justified

Maximum residual level (MRL) of ethoxyquin permitted in Japan varies among food items. It is clear that within the meaty foods the MRL for ethoxyquin ranges between 0.005 and 5 ppm. The maximum limit in many foods (including fish) is 1 ppm, whereas in the MRL values considered for rejection of Indian and Vietnamese appears to be is 0.01 ppm shrimp and the details can be ascertained from the following web link.

(http://www.seafood.vasep.com.vn/Daily-News/53_6146/VASEP-submitted-two-measures-to-solve-Ethoxyquin-problem.htm ; http://www.seafood.vasep.com.vn/Daily-News/53_6129/Japans-ethoxyquin-restrictions-in-shrimp-imports-are-unreasonable-compared-to-US-EU.htm; http://www.mhlw.go.jp/english/topics/importedfoods/12/xls/12-09a.xls)

It is interesting to note that as per the Japanese Food Chemical Research Foundation, there is no MRL for Ethoxyquin residues in any crustaceans including shrimp (http://www.m5.ws001.squarestart.ne.jp/foundation/fooddtl.php?f_inq=20400). There are currently no maximum residue limits (MRLs) in the European Union for any of the synthetic antioxidants in food products from farm animals. In contrast, Japan has set MRLs of 10 ppm for BHT 1 ppm for ethoxyquin and 0.5 ppm for BHA in fish. BHT and BHA, Butylatedhydroxytoluene and Butylatedhydroxyanisole respectively are other synthetic antioxidants used in animal feeds. US has banned the use of ethoxyquin in human food and the residual levels permitted is up to 5 ppm. But in animal feeds its usage up to 150 ppm is permitted.

The MRL of ethoxyquin fixed by Japan is extremely low and an unexpected rapid enforcement. As temporary way out it would be better to follow the approach by Vietnam. Based on the acceptable daily intake of ethoxyquin (0.005mg/kg human bodyweight; (http://www.codexalimentarius.net/pestres/data/pesticides/details.html?id=35), established by FAO/WHO, Vietnam asked Japan to refix the MRL for Ethoxyquin in shrimp as 1 ppm which is similar to MRL for residues in finfish. India could also request Japan to reconsider increasing the level to 1 ppm. It is pertinent to note that USDA has permitted ethoxyquin MRL as 0.5 ppm in most of the human food items. It is pertinent to note that most of the countries including US and the EU and the international agencies like CODEX have not prescribed any limit for etthoxyquin in fish and shrimp.

From the above information it is clear that Japan's standard of 0.01 ppm is a default and impractical standard. This stringent level of MRL for ethoxyquin has no scientific basis and not based on the risk assessment of ethoxyquin residues in human food products.

4. Long term strategies in addressing this issue

4.1 Research interventions

- Studies to establish the fate and depuration of ethoxyquin in shrimps is mandatory to ascertain depuration duration and frame guidelines in this concern.
- The concentration in shrimp tissue at the time of harvest and effect of freezing and storage on the residual concentration need to to be studied in detail.
- The effect of other synthetic antioxidants like BHT or BHA and its residual effect as well as depuration period has also to be studied.

- Natural antioxidants could be considered, but they will be too expensive to be used in shrimp feeds at present. Attempts can be initiated to produce cheaper sources.
- Since the problem is due to the fish meal used in feed, the search for alternate plant proteins to be intensified.

4.2 Policy interventions

- The alternates for ethoxyquin will be BHA and BHT. However, they also may cause health problems too, and their efficacy is lower than that of ethoxyquin. Their usage may be considered based on the needs.
- The addition of ethoxyquin in fishmeal may be determined based on the distance of the user from production site, duration and nature of storage etc. However proper certification and monitoring antioxidant level in fish meal prior to its inclusion in feed may help the feed manufacturer to have a control on its level in the feed.
- Standard need to be developed for the use of antioxidants in feed

5. Preliminary work done at CIBA:

Cultured tiger shrimp from West Bengal with an average body weight of 35 g were collected and analysed for the ethoxyquin residues. Shrimps were processed into edible portion and non-edible portion. The non-edible portion mainly comprised of head, hepatopancreas and exo skeleton. Analysis was carried out in the whole shrimp, edible portion and non-edible portion. Results showed that ethoxyquin is concentrated in the non-edible portion and the levels obtained were in the range of **12, 24, 62 ppb** in three samples. The residues were below detectable level in the edible portions of the same sample. Further the feed and fishmeal samples collected during the same period were found to be free of ethoxyquin residues. This study has indicated that ethoxyquin is mainly concentrated in the non-edible portions like hepatopancreas and exoskeleton.

In order to find out the depuration period an experiment is being planned in the juvenile tiger shrimp which will help in ascertaining the withdrawal period.

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25.11.2012, Updated version uploaded on 10th April 2013