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Food safety and added value of Icelandic fishmeal

Determination of toxic and non-toxic arsenic species in fish meal

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Aim

Determine the total arsenic concentration in Icelandic fish meal and screen for seasonal differences.

Develop novel analytical techniques for simultaneous determination of toxic and nontoxic arsenic species in fish meal.

Evaluate the number and quantity of toxic arsenic species in Icelandic fish meal.

Blue whiting *(Micromesistius poutassou)* © Jón Baldur Hliðberg; www.fauna.is

Herring *(Clupea harengus)* © Jón Baldur Hliðberg; www.fauna.is

Capelin *(Mallotus villosus)* © Jón Baldur Hliðberg; www.fauna.is

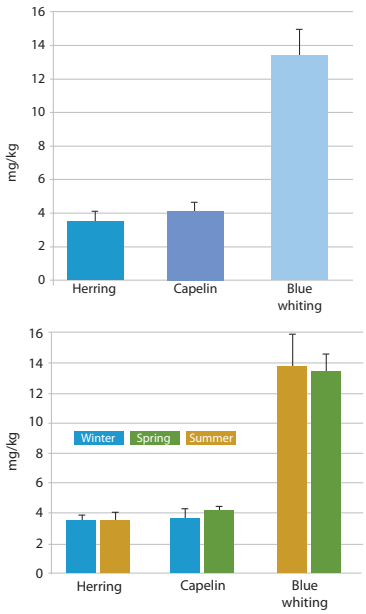

Figure 1. Average total arsenic concentrations for three fish meals.

As species	Herring	Blue whiting	Capelin
AB	WS	WS	WS+LS?
AC	WS	WS	WS
AB	-	WS?	WS+LS
TMAO	WS	-	WS
DMA(III)	LS	LS	LS
DMA(V)	-	-	-
MA(III)	-	-	-
As(III)	LS	LS	LS?
As(V)	-	-	WS
Unknown	WS	WS	WS

Table 1. Detected arsenic species in the fish meal samples. WS stands for water-soluble fraction, LS stands for lipid soluble fraction*.
*The reported analytes in Table 1 are products of lipid soluble arsenicals that have been hydrolyzed[6] from the lipid-soluble fraction

Introduction

In the biosphere arsenic is found as organic and inorganic compounds[1]. Arsenic is a human toxin and carcinogen affecting the lives of millions of people worldwide. Marine products have by nature a high concentration of total arsenic compared to e.g. agricultural products. Large portion of the arsenic in seafood is present as the organic compound arsenobetaine (AB)[2], which is non-toxic. Arsenic also occurs in various other forms in marine products, e.g. inorganic arsenic species (arsenite, arsenate), and methyl arsenic species which are toxic and pose a health risk[3]. Speciation of arsenic compounds for seafood is important as bioavailability and toxicity of arsenic is dependent on its chemical form. Fish meal samples of blue whiting, herring and capelin were used in this preliminary research.

Materials and Methods

Extraction of arsenicals

A sequential extraction[4,5] method was developed where the lipid-soluble arsenicals are first extracted into a non-polar solvent, then the water-soluble arsenicals are extracted into a polar solvent and the last step is a measurement of the arsenic concentration in the insoluble residue. The combined results of these three steps add up to the total As concentration of the sample. This method was applied to samples of each fish meal type with recovery rates ranging from 82-111%.

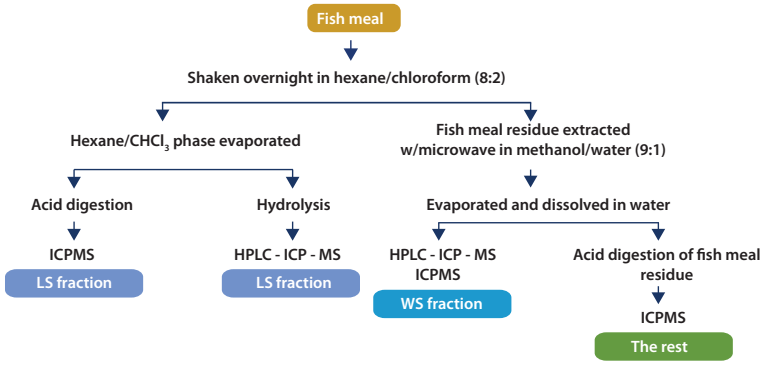

Figure 2. Schema of the sequential extraction method

Results and Discussion

Preliminary results of speciation

The preliminary results of speciation give an estimation of which arsenicals can be found in the three types of fish meal and an estimated concentration. The water soluble fraction accounts for 50-90% of the total arsenic concentration where arsenobetaine is the main constituent for all three fish meal types. Other arsenicals can be found in a lesser magnitude in both fractions. Table 1 reveals that a difference was observed in the arsenic species present in the three fish meal types.

Total arsenic concentration

Total arsenic concentration was determined in 20 samples of three different fish meal types. The total arsenic concentration differs for each fish meal type, ranging from 2,5-16,2 mg As/kg. The aim is to analyse ten samples of each fish meal type in every season. Presently, two seasons have been compared. No statistically significant seasonal difference between the total amount of arsenic in the fish meal types analysed to date has been observed.

Conclusion

Total arsenic concentration varies between fish meal types where blue whiting samples have roughly three times higher concentration than capelin and herring samples. Results regarding seasonal difference are inconclusive at this time as only two seasons have been compared. An extraction method has been developed where the lipid and water soluble arsenicals are extracted in a sequential manner. Preliminary results of speciation reveal that the non-toxic species arsenobetaine is the main constituent for the three fish meal types and that other species can be found in lesser amounts

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