Melamine and formaldehyde in melamine plastic products

SELECTED SAMPLES FROM THE NORWEGIAN MARKET IN 2019

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Summary

Melamine plastic is a popular type of food contact material because the tableware is rather inexpensive, is durable and is produced in many colours and design. Residual monomers of melamine and formaldehyde may migrate out of the finished product into the foodstuffs. Specific migration limits for melamine and formaldehyde are set in European Commission Regulation.

In addition to traditional melamine plastic with inorganic fillers, bamboo fiber has also been used in some products together with melamine resin. The aim of the present project was to sample melamine tableware from the Norwegian market and test if migration of melamine and formaldehyde complies with present regulation.

In total 30 samples of tableware were analysed. Migration test results found 2 non-compliance samples. Both were of the type containing bamboo fiber. One sample was non-compliance with both melamine and formaldehyde (formaldehyde only in 1 out of 4 replicates) and one sample was non-compliance with respect to melamine.

The frequency of detection of melamine and formaldehyde were higher in the samples containing bamboo fiber and the highest amount of migration were also found in this group of samples. However, migration in some of the samples without bamboo fiber were higher than in samples containing bamboo fiber.

The EU Commission has published a so-called “bamboo note”. This note states that bamboo cannot be used as an additive in plastic materials. Hence, these products are not in accordance with the plastics regulation. The Norwegian Food Safety Authority is following up on this issue. We have published information on this, here: Matkontaktmaterialer av plast som inneholder bambus er ikke tillatt | Mattilsynet

Norsk sammendrag

Melaminplast er en populær type matkontaktmateriale fordi serviset er ganske billig, er holdbart og er gjerne i mange farger og design. Restmonomerer av melamin og formaldehyd kan migrere fra det ferdige produktet over i matvarene. Spesifikke migrasjonsgrenser for melamin og formaldehyd er underlagt EU-kommisjonens forordning.

I tillegg til tradisjonell melaminplast med uorganiske fyllstoffer, er bambusfiber også brukt i noen produkter sammen med melaminresiner. Målet med dette prosjektet var å ta ut melaminservise fra det norske markedet og analysere for om migrasjon av melamin og formaldehyd er i samsvar med gjeldende regulering.

Totalt ble 30 prøver av servise analysert. Resultater av migrasjonstestener fant 2 prøver som ikke overholdt grenseverdiene. Begge var av typen som inneholder bambusfiber. Én prøve overholdt ikke grenseverdiene for både melamin og formaldehyd (formaldehyd bare i 1 av 4 replikater) og en prøve overholdt ikke grenseverdien for melamin.

Hyppigheten av påvisning av melamin og formaldehyd var høyere i prøvene som inneholdt bambusfiber, og den høyeste mengden migrasjon ble også funnet i denne gruppen av prøver. Imidlertid var migrasjonen i noen av prøvene uten bambusfiber høyere enn i prøver som inneholdt bambusfiber.

EU-kommisjonen har publisert et notat som presiserer regelvkert om bambusprodukter. I dette notatet fremkommer det at bambus ikke kan brukes som tilsetning i plastmaterialer. Produktene er derfor ikke i henhold til plastforordningen. Mattilsynet følger denne problemstillingen opp og har publisert informasjon om dette her: Matkontaktmaterialer av plast som inneholder bambus er ikke tillatt | Mattilsynet

1 Preface

This investigation was performed in cooperation between Project Leader Julie Tesdal Håland, Norwegian Food Safety Authority, Chemical Safety and EEA Section and Senior Adviser Tommy Licht Cederberg and Laboratory Engineer Lisbeth Krüger Jensen, Technical University of Denmark (DTU), National Food Institute, Research Group for Analytical Food Chemistry.

The laboratory work on analysis of migration of melamine and formaldehyde from melamine plastic products was performed at DTU.

The report was prepared by Senior Adviser Tommy Licht Cederberg and Laboratory Engineer Lisbeth Krüger Jensen, DTU in cooperation with project Leader Julie Tesdal Håland, The Norwegian Food Safety Authority.

The DTU DOCX-number was 19/1031455 and the Norwegian Food Authority' ePhorte number was 2019/28619

2 Background and aim of project

Melamine plastic is used for the manufacture of food contact materials for repeated use. The items does not break easily, are rather inexpensive and as they are produced in many colours, shape and design they have become popular tableware in many homes.

The resin is made from a reaction between the monomers melamine and formaldehyde and the melamine products are made by thermal compression moulding after addition of pigment, fillers etc. From the finished product residues of unreacted monomers may migrate into foodstuffs.

In recent years the use of organic fillers, especially bamboo fiber, in melamine plastic has been used to market certain products with labels such as “ecofriendly”, “biodegradable”, “organic” and “made from renewable resources”. Besides potential misleading labelling, official control analyses in e.g. Germany has demonstrated frequent non-compliance with regards to migration of melamine and formaldehyde from this type of food contact materials.

The aim of the present project is to sample melamine tableware from the Norwegian market and test if migration of melamine and formaldehyde complies with present regulation.

3 Regulation

European Commission Regulation No. 10/2011 on plastic materials and articles intended to come into contact with food applies to melamine plastic tableware. Specific migration limit (SML) has been set for melamine and formaldehyde. See Table 1.

Table 1. Specific migration limit (SML) laid down in Commission Regulation (EU) 10/2011

Substance	**Specific migration limit (SML) mg/kg food or food simulant**
Melamine	2.5
Formaldehyde	15

4 Materials and methods

4.1 Sampling

The melamine tableware were sampled in two periods. One from March 1, 2019 to April 30, 2019 and one from July 9, 2019 to September 26, 2019 and received at the Technical University of Denmark from April 26, 2019 to May 13, 2019 and August 21, 2019 to October 17, 2019 respectively.

Samples of the type melamine plastic tableware were collected at importers or at retail shops in Norway. Sampling was conducted in three Norwegian Food Safety Authority regions: “Greater-Oslo”, “East” and “South and West”. The food inspectors from the regions forwarded the samples to DTU with the accompanying documentation.

DTU received in total 30 samples. From the sample documentation and information on the packaging it could be observed that ten samples were made of melamine resin and eighteen samples were made of a mixture of bamboo fiber and melamine resin. Two samples did not contain melamine resin, but one was made of a mixture of bamboo fiber and polypropylene polymer and one from sugar cane fiber.

A few of the samples of tableware were received as a set of more items. For example, a dining set with a cup, a plate and a bowl or with cup, plate, knife, fork and spoon. In that case the cup was selected for migration test, and if non-compliant a plate or bowl was tested as well. That was the case for one of the tested samples.

The number of tested samples divided in tableware category and product type is shown in Table 2. Detailed sampling information is given in Annex B and pictures of the samples can be seen in Annex C.

Table 2. Types of melamine plastic tableware samples tested in the project.

FCM Sample type	M	B+M	B+PP	S
Cups	1	13	1	
Plates	2	2		
Bowls	5	3		1
Containers	2	1		
Total	**10**	**19**	**1**	**1**

Abbreviation for product type of received samples:
M: Melamine resin
B+M: Bamboo fiber and melamine resin
B+PP: Bamboo fibre and polypropylene polymer
S: Sugar cane fiber

4.2 Migration test conditions

The requirements for migration test of repeated use articles as given in Regulation 10/2011 were followed. In the technical guidelines for testing of kitchenware it is stated that test with 3% acetic acid as food simulant represents the worst case migration from melamine plastic (EURL 2011).

For repeated use articles three consecutive migration tests have to be carried out and the results from the last test are used for compliance check.

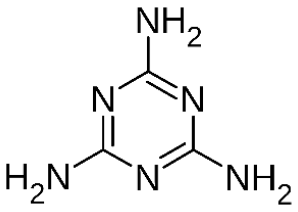
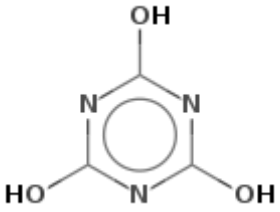
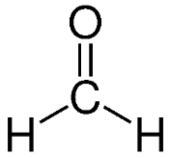
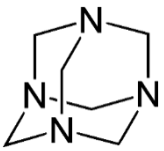
The samples were filled with simulant, 3% acetic acid, up to 0.5 cm from the rim. The simulant was preheated, and the items were covered and placed in an oven at 70°C for 2 hours.

4.3 Analysis of melamine and formaldehyde

An accredited analytical method developed at DTU, based on liquid chromatography tandem mass spectrometry (LC-MS/MS), were used for the analyses of melamine and formaldehyde.

The method FA479.1. “Determination of melamine, cyanuric acid and formaldehyde in food simulant 3% acetic acid by LC-MS/MS” determine the concentration of melamine and formaldehyde as well as cyanuric acid and hexamethylenetretramine (HMTA). HMTA is a precursor of formaldehyde and is commonly used in the production of melamine plastic. Analytically HMTA is converted to formaldehyde and is determined as such. Cyanuric acid is an impurity which can be formed during melamine production. In Figure 1 chemical structures of the analysed compounds are shown.

Figure 1. Names, chemical structures and information for compounds included in the analytical method.

 Melamine CAS 108-78-1 MW 126.123 $C_3H_6H_6$	 Cyanurid acid CAS 108-80-5 MW 129.074 $C_3H_3N_3O_3$
 Formaldehyde CAS 50-00-0 MW 30.026 CH_2O	 Hexamethylenetretramine (HMTA) CAS 100-97-0 MW 140.186 $C_6H_{12}N_4$

The method is based on the principles described in CEN standard 13130 covering materials and articles in contact with foodstuffs. Part 23 describes determination of formaldehyde and HMTA and part 27 determination of melamine in food simulants.

LC-MS/MS parameters

LC-MS/MS is used for detection of the analytes as it is a sensitive and specific technique (DS/EN 16858:2017). Formaldehyde is detected after derivatization with acetyl acetone (DS/CEN/TS 13130-23:2005).

A Bruker EVOQ Elite LC-MS/MS instrument with ESI was used. In Annex A the LC-MS/MS instrumental parameters are shown.

For melamine and cyanuric acid the column was a TSKgel Amide (250*2 mm, 5 µm). Eluent A: 10 mM ammonium acetate, eluent B: acetonitrile. Injection volume 2 µl, flow 0.35 ml/min, column temperature 30°C, gradient 0 min. 10% A, 9 min. 65% A, 11 min. 90% A, 12.5 min. 10% A to end at 22 min.

For formaldehyde the column was an Aquity UPLC BEH C18 (100*2.1 mm, 1.7µm). Eluent A: MilliQ water. Eluent B: Acetonitrile. Injection volume 2 µl, flow 0.2 ml/min, column temperature 30°C, gradient 0 min. 10% A, 5 min. 90% A, 6.1 min. 10% A to end at 9 min.

An analytical sequence included calibration solutions, procedure blank, spike addition sample in duplicate, reference material (FAPAS 1292 for melamine and FAPAS 1294 for formaldehyde, samples.

Calibration standard solutions were used at 8 levels (0, 5, 10, 50, 100, 250, 500 and 1000 ng/ml).

Sample preparation

Melamine and cyanuric acid: 100 µl 3% acetic acid food simulant + 800 µl 3% acetic acid + 100 µl internal standard solution.

Formaldehyde: 50 µl 3% acetic acid food simulant + 250 µl internal standard solution + 500 µl acetyl acetone solution + 1.7 ml milliQ water. Derivatization is performed in water bath at 60°C for 10 min.

Detection limit, quantification limit and analytical uncertainty

The achieved detection and quantification limits and analytical uncertainty of the analytical method is shown in Table 3.

Table 3. Detection limit (LOD), quantification limit (LOQ) and expanded uncertainty.

Substance	LOD mg/kg food simulant	LOQ mg/kg food simulant	Expanded uncertainty %
Melamine	0.02	1	10
Cyanuric acid	0.02	1	8
Formaldehyde	0.06	1.5	18*

*: Above 7.5 mg/kg

Presentation of results

In order to check compliance of specific migration limit the concentration of melamine and formaldehyde obtained after migration test should be converted to migration value in units of mg/kg food or food simulant (Regulation No 10/2011).

For articles that are fillable and have a volume in the range of 500 ml and up to 10 liters or are (intended to be) in contact with food for infants and young children the actual surface to volume ratio are used.

For articles that have a volume below 500 ml or higher than 10 liters the results needs to be corrected to a surface to volume ratio of 6 dm^2/kg of food.

5 Results and discussion

In the present project, 30 samples of melamine plastic tableware were tested for compliance with specific migration limits for melamine and formaldehyde. Analytical certificates with results and assessment of results were sent to the Norwegian Food Safety Authority.

Information regarding the type of samples (product labelling, sampling date, sampling place, country of origin etc.) is listed in Annex B. Pictures of the samples are shown in Annex C.

For each sampling period the 15 samples were subjected to migration tests (three consecutive migration tests) and if test results were higher than half the SML for melamine or formaldehyde, the sample were migration tested in triplicate. In addition, some samples were tested in triplicate as part of the analytical sequence setup.

Out of the 30 samples, 6 samples were selected to triplicate migration test due to high enough results from the first analysis. In Table 4 all results for melamine and formaldehyde from the 3rd migration test are shown.

In none of the samples were cyanuric acid determined above the detection limit of 0.02 mg/kg.

Conversion of HMTA to formaldehyde by sulfuric acid treatment were tried for some of the samples. The amount detected were generally low and below 2 mg/kg. However, the blank levels were higher than with the direct formaldehyde determination and in combination with increased expanded uncertainty the higher levels of formaldehyde from HMTA would not add significantly to the result used for compliance check. It was therefore decided only to report and use formaldehyde concentration without HMTA conversion for compliance check.

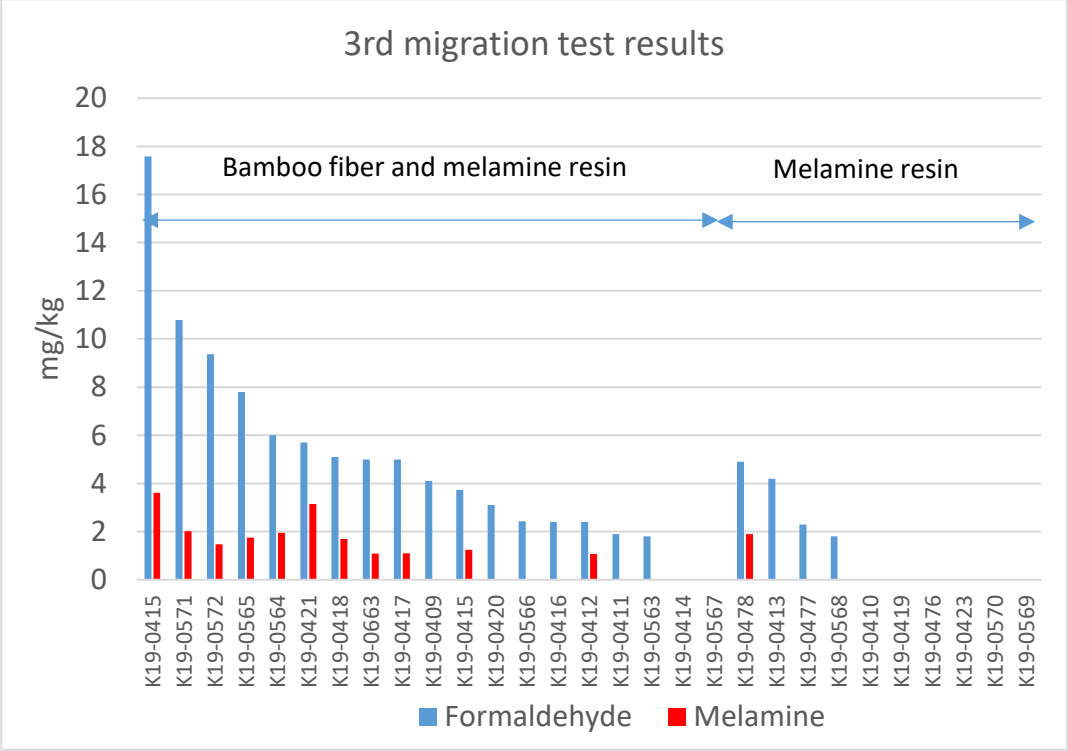
Two samples had results significantly above the SML. Sample number K19-0415, a cup, exceeded SML for melamine in four individual test results, and in one of the test formaldehyde was also exceeding the SML. In sample number K19-0421, a cup, melamine exceeded the SML in four individual test. Both the samples were products with bamboo fiber together with melamine resin. Sample K19-0415 was received as a dinner set. The bowl from the set was migration tested as well. Both melamine and formaldehyde were determined but well below SML values.

Two samples were received which did not contain melamine plastic. K19-0662 was a cup made of bamboo fiber and polypropylene polymer and K19-0422 was a bowl for disposable use made of sugar cane fiber. In none of these samples melamine or formaldehyde were detected.

In Figure 2 a visual comparison of the test results can be seen for samples manufactured with and without bamboo fiber together with melamine resin. The frequency of detection of melamine or formaldehyde above the quantification limit is higher for samples containing bamboo fiber. In this group of samples, 17 out of 19 samples has detection of formaldehyde or melamine or both. For the group without bamboo fiber the numbers are 4 out of 10 samples. In the samples containing bamboo fiber the highest concentrations of formaldehyde and melamine are found. This is especially true for formaldehyde. Some of the melamine samples without bamboo fiber have higher migration than the samples containing bamboo fiber.

Although the number of samples in this study are limited the results reflect the same tendency as observed by reports to the European Commission RASFF Portal (the Rapid Alert System for Food and Feed).

Figure 2. Comparison of 3rd migration test results for samples made of mixture of bamboo fiber and melamine resin to samples made of melamine resin only.



Several other studies of migration behavior of melamine and formaldehyde from melamine plastic have shown that migration of residual monomers dominates at first, but progressive degradation of the resins occurs later during the lifetime of the product (Ebner, 2020; Mannoni, 2016; Lund, 2006; Bradley, 2005). The migration of monomers continues and even if migration is below SML from the start, SML can be exceeded later after ageing and long term use.

As melamine plastic food contact materials containing bamboo fiber often has higher migration of residual monomers in new items, it should be further investigated if addition of bamboo fiber as organic filler in melamine plastic increases the migration even more with ageing than traditionally melamine plastic articles without e.g. bamboo fiber.

Table 4. Results of 3rd migration test for melamine and formaldehyde (mg/kg)

Sample type	Plastic type	DTU sample ID	NFA sample ID	Sampling date	Country of origin	Surface to volume ratio	Melamine mg/kg	Formaldehyde mg/kg
Bowls	M	K19-0410	30419020823	03-04-2019	China	Actual	<1	<1.5
	M	K19-0419	Magretheskål	30-04-2019	The Nether-lands	Actual	<1	<1.5
	M	K19-0476	5	15-08-2019	China	6	<1	<1.5
	M	K19-0478	3	15-08-2019	China	Actual Infant and young children	1.75 2.65 1.87 1.30	4.9
	M	K19-0568	250919051876	24-09-2019	Unknown	6	<1	1.8
	B+M	K19-0411	250419024891 (2)	25-04-2019	China	6	<1	1.9
	B+M	K19-0414	2	29-04-2019	China	6	<1	<1.5
	B+M	K19-0415	3	29-04-2019	China	Actual Infant and young children	1.26 1.37 1.11	3.6 3.5 4.1
	S	K19-0422	Engangskål af sukkerrør (hvide)	07-03-2019	France	-	<1	<1.5
Containers	M	K19-0413	1	04-04-2019	Thailand	Actual	<1	4.2
	M	K19-0423	Sorte kantinebakker/ fade	07-03-2019	China	Actual	<1	<1.5
	B+M	K19-0663	5	26-09-2019	China	Actual	1.08	5

Table 4 continued. Results of 3rd migration test for melamine and formaldehyde (mg/kg)

Sample type	Plastic type	DTU sample ID	NFA sample ID	Sampling date	Country of origin	Surface to volume ratio	Melamine mg/kg	Formaldehyde mg/kg
Cups	M	K19-0570	0589203	24-09-2019	China	6	<1	<1.5
	B+M	K19-0409	30419020824	03-04-2019	China	6	<1	4.1
	B+M	K19-0415	3	29-04-2019	China	Actual Infant and young children	3.49* 3.63* 3.46* 3.88*	17.1 16.1 18.1 19.0*
	B+M	K19-0416	290419025565	11-04-2019	China	6	<1	2.4
	B+M	K19-0417	290419025560	25-04-2019	China	6	1.00 1.13 1.16	5.2 4.8
	B+M	K19-0418	290419025551	24-04-2019	China	6	1.7	5.1
	B+M	K19-0420	Gråt kaffekrus med låg	08-03-2019	China	6	<1	3.1
	B+M	K19-0421	Bambuskop med rosa mønster	30-04-2019	Unknown	6	3.00* 3.10* 3.14* 3.33*	5.7
	B+M	K19-0563	0589208	24-09-2019	China	6	<1	1.8
	B+M	K19-0564	0589209	24-09-2019	China	6	1.97 1.87 2.62 1.35	6

Table 4 continued. Results of 3rd migration test for melamine and formaldehyde (mg/kg)

Sample type	Plastic type	DTU sample ID	NFA sample ID	Sampling date	Country of origin	Surface to volume ratio	Melamine mg/kg	Formaldehyde mg/kg
Cups	B+M	K19-0565	0589202	24-09-2019	China	6	1.54 1.78 1.55 2.13	7.8
	B+M	K19-0566	0589201	24-09-2019	China	6	<1 <1 <1	1.9 2.7 2.7
	B+M	K19-0571	300919053533	09-07-2019	China	6	2.26 1.32 1.89 2.60	12.8 7.47 10.4 12.5
	B+M	K19-0572	300919053561	09-07-2019	Unknown	6	1.35 1.39 1.66	9.4 8.9 9.8
	B+PP	K19-0662	4	24-09-2019	China	6	<1	<1.5
Plates	M	K19-0477	4	15-08-2019	China	6	<1	2.3
	M	K19-0569	250919051882	24-09-2019	Unknown	6	<1	<1.5
	B+M	K19-0412	1	01-03-2019	China	6	1.07	2.4
	B+M	K19-0567	250919051895	24-09-2019	China	6	<1	<1.5

*: Migration test result significantly exceeding specific migration limit

Plast type:
M: Melamine resin
B+M: Bamboo fiber and melamine resin
B+PP: Bamboo fiber and polypropylene polymer
(S: Sugar cane fiber)

Consecutive migration tests and replicate migration tests

Triplicate migration tests were carried out on eleven samples. Formaldehyde and melamine were analysed in the migrates from the third migration test and for nine samples additional analyses of formaldehyde and melamine were carried out on migrates from each of the consecutive migration tests. The results are listed in Table 5.

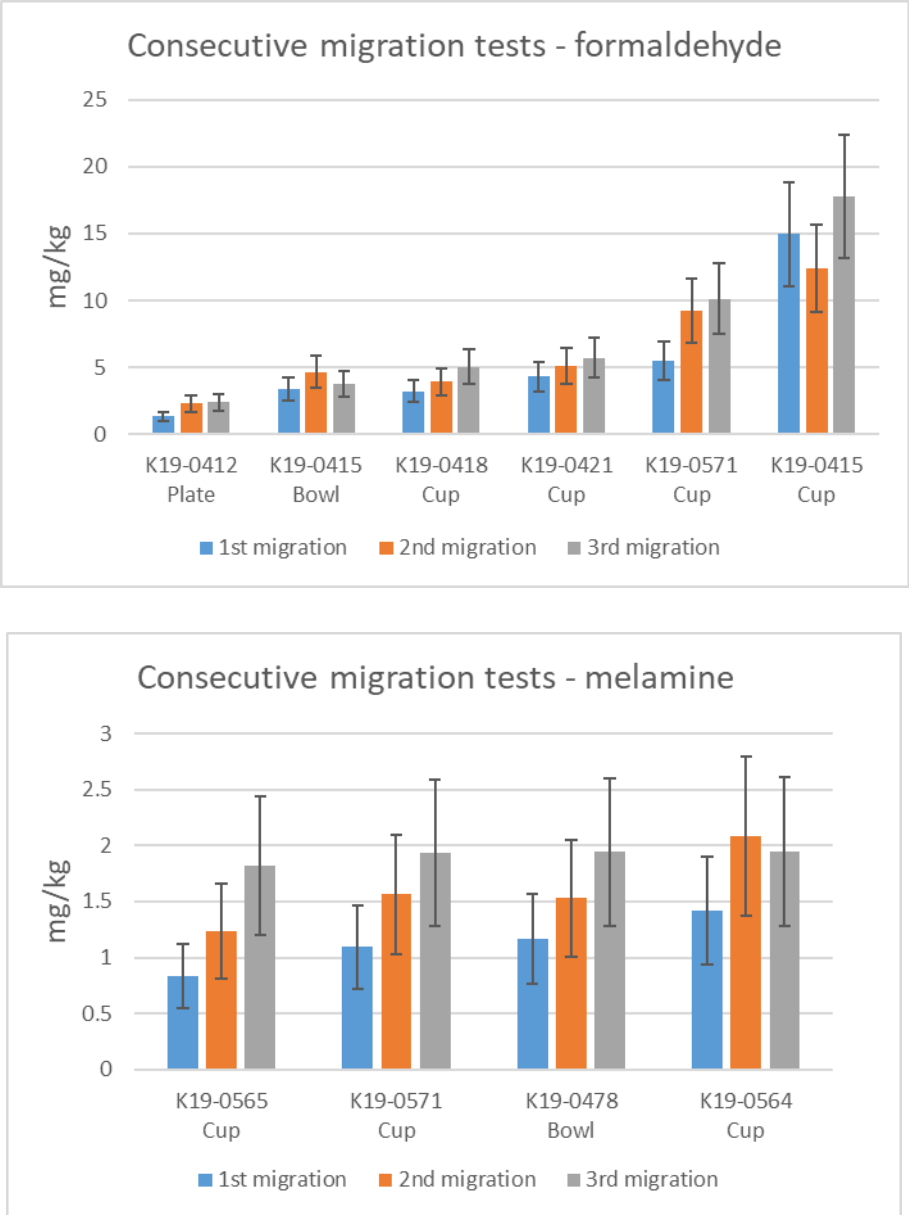
For the nine samples with migration results from each of the consecutive tests the determined migrations of formaldehyde and melamine are shown in Figure 3. An overall numerical trend of increasing migration from the first, to the second and to the third migration test can be observed. For two of the samples the formaldehyde migration deviates from this trend and for one of the samples migration of melamine did not increase steadily from the first to the third migration test. However, for all of the samples the third test has higher migration that the first test.

It is necessary to take the analytical uncertainty into account when evaluating the statistical significance of the numerical trend. The uncertainty is comprised of the analytical uncertainty from the determination of formaldehyde and melamine in the food simulant migrate, from the migration test and from inhomogeneity of the sample items (the analytical uncertainty alone has a relative standard deviation of 9% for formaldehyde and 5% for melamine). From the migration results in Table 5 an average relative standard deviation of 13% for formaldehyde and 17% for melamine migration has been calculated. Using a coverage factor of 2 the expanded uncertainty (95% confidence interval) is shown as error bars in Figure 3. Due to the relatively high variability of the migration test results it is in 9 out of 10 samples not possible to conclude that the three consecutive migration test show an increasing trend.

Table 5. Migration results of melamine and formaldehyde of individual consecutive migration tests and of sample replicates (mg/kg).

DTU sample ID	Product type	Plast type	Migration test	Melamine Sample replicates			Formaldehyde Sample replicates		
				1	2	3	1	2	3
K19-0412	Plate	B+M	1. migration test				1.31		
			2. migration test				2.26		
			3. migration test				2.37		
K19-0415	Cup	B+M	1. migration test				14.4	15.6	14.9
			2. migration test				7.05	19.7	10.5
			3. migration test	3.63	3.46	3.88	16.1	18.1	19.0
K19-0415	Bowl	B+M	1. migration test				2.55	3.72	3.69
			2. migration test				4.34	5.03	4.58
			3. migration test	1.26	1.37	1.11	3.60	3.53	4.07
K19-0418	Cup	B+M	1. migration test				3.21		
			2. migration test				3.93		
			3. migration test				5.01		
K19-0421	Cup	B+M	1. migration test				4.31		
			2. migration test				5.10		
			3. migration test	3.10	3.14	3.33	5.69		
K19-0478	Bowl	M	1. migration test	1.89	1.01	0.60			
			2. migration test	2.25	1.62	0.72			
			3. migration test	2.65	1.87	1.30			
K19-0564	Cup	B+M	1. migration test	1.24	1.72	1.29			
			2. migration test	2.06	2.90	1.28			
			3. migration test	1.87	2.62	1.35			
K19-0565	Cup	B+M	1. migration test	0.76	1.02	0.73			
			2. migration test	1.30	1.26	1.14			
			3. migration test	1.78	1.55	2.13			
K19-0571	Cup	B+M	1. migration test	0.76	1.15	1.39	3.83	6.11	6.48
			2. migration test	1.03	1.55	2.11	6.11	9.58	12.1
			3. migration test	1.32	1.89	2.60	7.47	10.4	12.5
K19-0417	Cup	B+M	3. migration test	1.00	1.13	1.16			
K19-0566	Cup	B+M	3. migration test	<1	<1	<1	1.88	2.68	2.72
K19-0572	Cup	B+M	3. migration test	1.35	1.39	1.66	9.44	8.93	9.75
K19-0662	Cup	B+PP	3. migration test	<1	<1	<1	<1.5	<1.5	<1.5

Figure 3. Migration of formaldehyde and melamine during consecutive tests of tableware. Average of triplicate migration tests except for K19-0412, K19-0418 and K19-0421, which are from single migration tests. Expanded uncertainty is shown as error bars.



6 Conclusion

The 30 received samples of melamine plastic tableware were subjected to migration test and analysed for melamine and formaldehyde. In 10 samples of traditional melamine plastic melamine and/or formaldehyde were detected above the quantification limit in 4 of them. In 19 samples containing bamboo fiber in addition to melamine resin the numbers of positive samples were 17. The highest migration results were found among the samples containing bamboo fiber.

Two samples of cups exceeded the specific migration limits (SMLs) and were non-compliance with EU regulation. One sample was non-compliance with both melamine and formaldehyde (formaldehyde only in 1 out of 4 replicates) and one sample was non-compliance with respect to melamine. Both of the samples were of the type with bamboo fiber in addition to melamine resin.

Results from each of consecutive migration test showed an overall numerical increase in migration from first to third migration test. However, for most of the samples the increase was not statistically significant.

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Annex A. LC-MS/MS instrument parameters

Melamine and cyanuric acid MS parameter:

Spray Voltage 3500 V (neg)/4500 V (pos)
Cone Gas Flow 20
Cone Temperature 350
Probe Gas Flow 40
Probe Temperature 375
Nebulizer Gas Flow 50
Manifold Temperature 40
Exhaust Gas Off
CID Gas 2,0 mTorr
Vacuum ~ 2,3e-5 mbar

Stof	Kvantifikations ion (CE)	Identifikations ion (CE)
Melamin (pos)	127.2 > 85.2 (16)	127.2 > 68.2 (27)
Cyanursyre (neg)	128.0 > 42.4 (13)	128.0 > 85.1 (7)
Melamin-$^{13}C_3$ (pos)	130.2 > 86.2(16)	
Cyanursyre-$^{13}C_3$-^{15}N (neg)	134.0 > 44.4 (12)	

Formaldehyde MS parameter:

Spray Voltage 4000 V (pos)
Cone Gas Flow 20
Cone Temperature 350
Probe Gas Flow 40
Probe Temperature 375
Nebulizer Gas Flow 50
Manifold Temperature 40
Exhaust Gas Off
CID Gas 2,0 mTorr
Vacuum ~ 2,3e-5 mbar

Stof	Kvantifikations ion (CE)	Identifikations ion (CE)
Formaldehyd	194.1 > 43.0 (23)	194.1 > 176.0 (12)
Formaldehyd-^{13}C3	197.1 > 43.0 (20)	

Annex B. Sampling information of samples for melamine and formaldehyde analyses

DTU sample ID	NFA sample ID	Sampling date	Received data	Product labelling	Product type	Sampling place	Country of origin	NFA region office
K19-0409	30419020824	03.04.2019	26.04.2019	Drikkekopp biodegradable	B+M	Sunkost Hvaltorvet	China	Region Øst avd. Vestfold
K19-0410	30419020823	03.04.2019	26.04.2019	Melamin tropic skål	M	Europris Sandefjord 440	China	Region Øst avd. Vestfold
K19-0411	250419024891 (2)	25.04.2019	02.05.2019	Biobu gusto skål liten 10x10	B+M	Utsalg /butikk. TingASAVD Stavanger	China	Avdeling Sør-Rogaland, Sirdal og Flekkefjord
K19-0412	1	01.03.2019	02.05.2019	Bamboo Fibre Products (Tallerken Ø 25,5 cm grå)	B+M	Festival AS, Søgne	China	Avdeling Sør-Rogaland, Sirdal og Flekkefjord
K19-0413	1	04.04.2019	07.05.2019	GN Pan 1/6, 17,6*16,2*6,5 cm 0,8 ltr, item no 99983748	M	Horeka AS, Lysevejen 16, 3531 Korkkleiva	Thailand	Søndre Buskerud
K19-0414	2	29.04.2019	07.05.2019	Fresk Bamboo Dinnerset Swan. Varenummer FD400-62	B+M	Lykkeland AS, Terminalen 9, 3414 Lierstranda	China	Søndre Buskerud
K19-0415	3	29.04.2019	07.05.2019	Tilo bambus spisesett	B+M	Princess avd hovedkontor/adm/ lager,	China	Søndre Buskerud

						Kjeppestadveien 40, 1400 Ski		
K19-0416	290419025565	11.04.2019	10.05.2019	Kaffekopp bambus - Excellent Houseware	B+M	Fr Schutz AS, Storebotn Næringspark, Klep-pestø (importør/grossist)	China	Avdeling Bergen og omland
DTU sample ID	NFA sample ID	Sampling date	Received data	Product labelling	Product type	Sampling place	Country of origin	NFA region office
K19-0417	290419025560	25.04.2019	10.05.2019	Glass, bambusfiber	B+M	Upstairs Lagunen, Lagunen Stor-senter, Lagunen 1, 5239 Rådal (detaljist)	China	Avdeling Bergen og omland
K19-0418	290419025551	24.04.2019	10.05.2019	To Go Cup bambus	B+M	Søstrene Grene Lagunen Stor-senter Lagunen 1, 5239 Rådal (importør/detaljist)	China	Avdeling Bergen og omland
K19-0419	Magretheskål	30.04.2019	10.05.2019	Rosti Mepal Margrethe bakebolle 2L	M	Jernia Torggata Olso	The Nether-lands	Region Stor-Oslo, avd. OAØ
K19-0420	Gråt kaffekrus med låg	08.03.2019	13.05.2019	Kaffekrus med lokk	B+M	Clas Ohlson Torggata	China	Region Stor-Oslo, avd. OAØ

K19-0421	Bambuskop med rosa mønster	30.04.2019	13.05.2019	Bambuskopp	B+M	Tanum Byporten	Unknown	Region Stor-Oslo, avd. OAØ
K19-0422	Engangskål af sukkerrør (hvide)	07.03.2019	13.05.2019	Engangsskål av sukkerør	S	pulsiva.com /EM Group Skandinavia NUF	France	Region Stor-Oslo, avd. OAØ
K19-0423	Sorte kantinebakker/fade	07.03.2019	13.05.2019	Melaminkantine Fundale GN 1/3	M	Vega-direkt.no /EM Group Skandinavia via NUF	China	Region Stor-Oslo, avd. OAØ
K19-0476	5	15.08.2019	21.08.2019	Zoo melamine plate & bowl set	M	Extra leker, Stavanger	China	Avdeling Sør-Rogaland, Sirdal og Flekkefjord
DTU sample ID	NFA sample ID	Sampling date	Received data	Product labelling	Product type	Sampling place	Country of origin	NFA region office
K19-0477	4	15.08.2019	21.08.2019	Melamine Plate	M	Brødrene Pedersen	China	Avdeling Sør-Rogaland, Sirdal og Flekkefjord
K19-0478	3	15.08.2019	21.08.2019	Yummy bowl, happy dots, powder	M	Baby Shop - Stavanger	China	Avdeling Sør-Rogaland, Sirdal og Flekkefjord
K19-0563	0589208	24.09.2019	30.09.2019	Nuby Bamboo & Maize Eco-Friendly drikkekopp	B+M	Coop OBS Haugenstau	China	Oslo, Asker og Bærum

K19-0564	0589209	24.09.2019	30.09.2019	William Morris Gallery Ecoffee Cup av Bamboo	B+M	Black Cat kaffe og tehus	China	Oslo, Asker og Bærum
K19-0565	0589202	24.09.2019	30.09.2019	Sass & Bell Tiki Toucan Cup (rosa)	B+M	LOCO Torggata	China	Oslo, Asker og Bærum
K19-0566	0589201	24.09.2019	30.09.2019	Sporty dining set/måltidssett (kop, tallerken, skål)	B+M	Lagerhaus Grensen	China	Oslo, Asker og Bærum
K19-0567	250919051895	24.09.2019	30.09.2019	Lamaskål art. 7875266	B+M	Dag´s Marked A/S	China	Afd. Vestfold
K19-0568	250919051876	24.09.2019	30.09.2019	85-0228 melaminskål	M	Biltema Sandefjord	Unknown	Afd. Vestfold
K19-0569	250919051882	24.09.2019	30.09.2019	85-5040 (tallerken)	M	Biltema Sandefjord	Unknown	Afd. Vestfold
DTU sample ID	NFA sample ID	Sampling date	Received data	Product labelling	Product type	Sampling place	Country of origin	NFA region office
K19-0570	0589203	24.09.2019	30.09.2019	Kay Bojesen Denmark barnesett av melamin (3 dele) - norsk alfabet	M	Kitch´n Torggata	China	Oslo, Asker og Bærum
K19-0571	300919053533	09.07.2019	04.10.2019	Bamboo Travel Mug Sea Turtle Akvariet Bergen 09426AKB	B+M	Akvariet i Bergen, Nordnesbakken 4, 5005 Bergen (importør/detaljist)	China	Avdeling Bergen og omland

K19-0572	300919053561	09.07.2019	04.10.2019	Filibabba bambus kopp rosa	B+M	Sprell Bergen (detaljist)	Unknown	Avdeling Bergen og omland
K19-0662	4	24.09.2019	17.10.2019	Kopp med lokk (300ml)	B+PP	TGR/Flying Tiger, Nedre Storgate 7, Drammen	China	Søndre Buskerud
K19-0663	5	26.09.2019	17.10.2019	Matboks "Floraal bamboo lunch box"	B+M	Norli AS avd Magasinet, Drammen, Nedre Storgate 2, Drammen	China	Søndre Buskerud

B+M: Bamboo fibre and melamine resin
M: Melamine resin
B+PP: Bamboo fibre and polypropylene polymer
S: Sugar cane fibre

Annex C. Photos of the surveyed samples

K19-0409 Cup (B+M)	K19-0410 Bowl (M)	K19-0411 Bowl (B+M)
		
K19-0412 Plate (B+M)	K19-0413 Container (M)	K19-0414 Bowl (B+M)
		
K19-0415a Cup (B+M)	K19-0415b Bowl (B+M)	K19-0416 Cup (B+M)

		

K19-0417 Cup (B+M)	K19-0418 Cup (B+M)	K19-0419 Bowl (M)
		
K19-0420 Cup (B+M)	K19-0421 Cup (B+M)	K19-0422 Bowl (S)
		
K19-0423 Container (M)	K19-0476 Bowl (M)	K19-0477 Plate (M)

		

K19-0478 Bowl (M)	K19-0563 Cup (B+M)	K19-04564 Cup (B+M)
		
K19-0565 Cup (B+M)	K19-0566 Cup (B+M)	K19-0567 Plate (B+M)
		
K19-0568 Bowl (M)	K19-0569 Plate (M)	K19-0570 Cup (M)

		

K19-0571 Cup (B+M)	K19-0572 Cup (B+M)	K19-0662 Cup (B+PP)
		
K19-0663 Container (B+M)		
		

B+M: Bamboo fibre and melamine resin
M: Melamine resin
B+PP: Bamboo fibre and polypropylene polymer
S: Sugar cane fibre