Reports on tasks for scientific cooperation

Report of experts participating in Task 3.2.9

June 2004

Collection and collation of data on levels of 3-monochloropropanediol (3-MCPD) and related substances in foodstuffs

Directorate-General Health and Consumer Protection

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1. FORWARD

Scientific Co-operation on Questions Relating to Food
The scope and limitations of this report

Council Directive 93/5/EEC "on the assistance to the Commission and co-operation by the Member States in the scientific examination of questions relating to food" was updated on 25 February 1993. It lays down a procedure whereby Member States of the European Union can focus their scientific resources in a co-ordinated manner on problems facing the Commission in the area of food. The individual tasks to be undertaken are agreed in consultation with the Member States who also determine in which tasks they wish to participate and the extent of their participation. Directive 93/5/EEC requires that an inventory of tasks be published at least every six months. This publication, which takes the form of a Commission Decision, specifies the participating Member States that provides co-ordination and the time limit for the completion of the task.

In general terms, tasks undertaken under scientific co-operation are designed to provide a factual basis to support a Commission action in the area of food. Such support may involve the provision of information as may be required, for example, by the Scientific Committee for Food (SCF) for its evaluation and advisory work or by the Commission's own services for the development of Community action.

The tasks themselves are carried out by a group of experts nominated by the National Authorities responsible for Scientific Co-operation in the Member States (the National Designated Authorities).

Although the scope of reports generated under the scientific co-operation procedure is restricted to essentially factual matters, presentation of inherently complex information without some reasoned interpretation and summary by specialists would be of limited value and even open to misleading conclusions. Such interpretation necessarily involves a degree of expert judgement.

It is therefore stressed that the interpretation and views expressed in this report are not necessarily those of the participating Member States or those of the European Commission.

2. INTRODUCTION

3-Monochloropropane-1,2-diol (3-MCPD) is the most commonly occurring of a group of chemical contaminants known as chloropropanols. Together with 1,3-dichloropropanol (1,3-DCP) it was originally identified as being formed during the production of the savoury ingredient, acid-hydrolysed vegetable protein (acid-HVP)[1]. 3-MCPD has since been found to occur in a range of other foods and food ingredients, most notably soy sauce. It is thought to occur as a result of processing, or less frequently from migration from certain food contact materials. Background information on 3-MCPD and other chloropropanols (1,3-DCP, 2-monochloro-1,3-propandiol (2-MCPD) and 2,3-dichloro-2-propanol (2,3-DCP)) is given in Annex 1.

In 2000, SCOOP Task 3.2.6[2] concerning the development of validated methods for evaluating 3-MCPD in foods was completed. This Task was successful in developing a validated method for analysing 3-MCPD and resulted in a report entitled "Provision of validated methods to support the Scientific Committee on Food's recommendations regarding 3-monochloropropane-1,2-diol in hydrolysed vegetable protein and other foods". It was noted during the Task that 3-MCPD occurrence data in foods other than soy sauce was scarce. Subsequently, Commission Decision 2001/773/EC of 26 October 2001[3] established Task 3.2.9 "Collection and Collation of data on levels of 3-monochloropropane-1,2-diol (3-MCPD) and related substances in foodstuffs". The UK and Sweden were designated as Member States to coordinate the Task.

Member States that participated in Task 3.2.9 were Austria, Denmark, Finland, France, Germany, Ireland, the Netherlands, Sweden and the UK. Norway also participated in the Task. The EC's DG Joint Research Centre assisting in the Task by being available to provide advice on analytical methodology. All participants supplied occurrence data and all participants except Austria and Norway supplied 3-MCPD dietary intake estimates. Details of participants are provided in Annex 3. Following the appointment of the UK and Sweden as co-ordinators, the timetable of the Task was decided jointly with representatives of the Commission. For administrative reasons, the deadline for the completion of the Task was extended[4].

Commission Regulation (EC) No. 466/2001[5] sets limits for a range of contaminants in certain foodstuffs including 3-MCPD in soy sauce and HVP. The limits for 3-MCPD in soy sauce and HVP have been set at 0.02 mg/kg based on the liquid product containing 40% dry matter. The regulation was formally adopted on 8 March 2001, and applied from 5 April 2002. This SCOOP Task will inform the review of this maximum level, detailed in article 5 of Commission Regulation (EC) No. 466/2001.

The primary objective of the Task was to gather information on the levels of 3-MCPD and other chloropropanols in a range of foods. An initial meeting on 3

May 2001 introduced participants to the Task and the surveys examining 3-MCPD in selected foods[6] and food ingredients[9] conducted by the UK's Food Standards Agency. Participants agreed that only occurrence data obtained after 1997 should be submitted as there was concern about the robustness of data acquired prior to that date. The format for collecting and sending occurrence data was agreed in order to allow the construction of tables for data collection by the co-ordinators. An adapted version of the Codex food categorisation system[7] was used to classify the food samples. The final agreed categorisation instructions, together with the list of food codes are given in Annex 2.

The second objective of this SCOOP Task was to give a best estimate of dietary exposure to 3-MCPD. As adequate national data were available, participants used their own soy sauce data to calculate exposure to 3-MCPD from soy sauce. However, as adequate national data for other foods were unavailable, it was decided that participants would use pooled 3-MCPD occurrence data to calculate dietary exposure to 3-MCPD from all other foods.

Data provided by participants were collected and reported by the co-ordinators to provide the following:

- a description of the status of 3-MCPD and other chloropropanol levels in foodstuffs in each participating country;

- an overview of the available information on chloropropanols in individual food products and ingredients;

- best estimates of 3-MCPD dietary intake from food for each participant.

3. OCCURRENCE OF CHLOROPROPANOLS IN FOOD

3.1. Calculation of mean 1 and mean 2

The range of limits of quantification (LOQ) of the methods of analysis used to obtain the data in this report together with the large number of results below the LOQ (<LOQ), complicated analysis of the data. Because of the uncertainties of the true chloropropanol level in samples with a reported level of <LOQ, two different values for individual results were assumed in order to calculate best estimate mean values to be used in the dietary intake estimates. The lower mean value (mean 1) was calculated assuming that the true level of chloropropanol in a sample where the reported chloropropanol level was <LOQ was 0 mg/kg. The second mean value (mean 2) was calculated assuming that the true level of chloropropanol in a sample where the reported chloropropanol level was <LOQ was between 0 mg/kg and the LOQ, this was estimated as LOQ/2.

Mean 1: all values classified as <LOQ were assumed to have a chloropropanol level = 0 mg/kg.
Mean 2: all values classified as <LOQ were assumed to have a chloropropanol level = LOQ/2.

Mean values in the report are quoted to 3 significant figures.

3.2. Sampling

It should be noted that some of the occurrence data provided by participants, especially those for soy sauce and soy sauce based products, are from targeted sampling of products suspected of containing high levels of chloropropanols. Accordingly, sampling methodologies used are not representative of the market share and therefore do not necessarily reflect true diets. This skewing of sampling and hence the percentage of samples found to have quantifiable levels of chloropropanols is likely to have resulted in an over estimation of the dietary intake estimates for 3-MCPD conducted using these occurrence data.

3.3. Occurrence of chloropropanols in soy sauce and soy sauce based products (food group 12.6.4)

Data for soy sauce (group 12.6.4) were considered separately due to the large number of analysis results for this food group. Table 1 summarises the chloropropanol occurrence data provided by participants for each type of soy sauce. Table 2 breaks down the 3-MCPD data in this summary table to provide more detailed information about 3-MCPD values for each soy sauce type. Each participant used their own analysis results to estimate 3-MCPD intakes from soy sauce. Table 3 provides a breakdown of soy sauce 3-MCPD data by participant.

Table 4 summarises 3-MCPD occurrence in soy sauce by country of origin. Table 5 provides a breakdown of the occurrence data for 3 other chloropropanols (2-MCPD, 1,3-DCP and 2,3-DCP) in soy sauce.

Tables 24-27 give details of the occurrence of chloropropanols in individual samples of soy sauce and soy sauce based products. It is assumed that none of the reported chloropropanol analyses results have been corrected for dry matter content.

3.3.1. Occurrence of 3-MCPD in soy sauce and soy sauce based products (group 12.6.4)

All 10 participants provided 3-MCPD data for soy sauce and soy sauce based products, with Germany (692) and Austria (316) being the major contributors to the total of 2035 analysis results (table 3), 714 (35%) of these 2035 samples contained quantifiable levels of 3-MCPD. The majority of samples tested were described as soy sauce (887 in total; 328 with quantifiable levels of 3-MCPD), light soy sauce (233 in total; 89 (38%) with quantifiable levels of 3-MCPD), dark soy sauce (211 in total; 59 (28%) with quantifiable levels of 3-MCPD), mushroom soy sauce (171 in total; 105 (61%) with quantifiable levels of 3-MCPD) and oyster sauce (132 in total; 32 (24%) with quantifiable levels of 3-MCPD) (table 2). Participants used their own 3-MCPD data to estimate 3-MCPD intake from soy sauce, here analysis of this data is broken down by participant[a]:

3.3.1.1. Austria

130 of the 316 (41%) samples for which Austria submitted results contained quantifiable levels of 3-MCPD. The highest 3-MCPD value was 104 mg/kg, observed for a soy sauce (12.6.4.13) sample.

Group 12.6.4.13 (soy sauce) accounted for 80 of the 130 results with quantifiable levels of 3-MCPD and had a mean 1 value of 9.38 mg/kg compared to a mean 1 of 6.60 mg/kg for all Austrian data. Mushroom soy sauce (group 12.6.4.6) also contributed to 3-MCPD levels with 17 of the 29 samples analysed (59%) containing quantifiable levels of 3-MCPD (mean 1 = 12.6 mg/kg). The overall mean 1 and mean 2 values were 6.60 and 6.69 mg/kg respectively.

3.3.1.2. Denmark

27 of the 43 (63%) samples for which Denmark submitted results contained quantifiable levels of 3-MCPD.

[a] In section 3.3.1 where 'mean' values are quoted for individual food groups, they are calculated taking into consideration all samples, irrespective of the LOQ of the method of analysis used to analyse that sample. For example, the mean 1 value quoted for group 12.6.4.13 for Austria of 9.38 mg/kg is derived using all 154 samples from that food group.

Of the 43 analysis results provided, 27 (63%) contained quantifiable levels of 3-MCPD with the highest 3-MCPD level of 90.0 mg/kg being observed for a dark soy sauce sample (group 12.6.4.2). All 5 samples of light soy sauce (group 12.6.4.4) tested contained quantifiable amounts of 3-MCPD with 3 of the levels above 10 mg/kg. Both overall mean 1 and mean 2 values were 12.7 mg/kg.

3.3.1.3. Finland

53 of the 163 (33%) samples for which Finland submitted results contained quantifiable levels of 3-MCPD.

Both overall mean 1 and mean 2 values were 22.6 mg/kg. This relatively high mean value was largely due to high levels of 3-MCPD in samples in groups 12.6.4.11 (seasoning sauce) and 12.6.4.13 (soy sauce). These groups contained a total of seven samples with levels of 3-MCPD above 145 mg/kg, with a 3-MCPD value of 940 mg/kg reported in one seasoning sauce sample. Also over 20% of the samples in group 12.6.4.6 (mushroom soy sauce) contained levels of 3-MCPD above 10 mg/kg.

3.3.1.4. France

39 of the 73 (53%) samples for which France submitted results contained quantifiable levels of 3-MCPD.

3-MCPD levels were highest for group 12.6.4.13 (soy sauce), particularly in the 32 samples analysed using a method with a limit of quantification of 0.8 mg/kg. 8 of these 32 samples containing levels of 3-MCPD between 1 and 10 mg/kg and 16 of these 32 samples contained levels above 10 mg/kg. The mean 1 value of 21.1 mg/kg for these samples contributed greatly to the overall mean 1 value (for the total 73 samples) of 9.36 mg/kg. No other sub group had a mean 1 value greater than 1.10 mg/kg. The overall mean 1 and mean 2 values were 9.36 and 9.41 mg/kg respectively.

3.3.1.5. Germany

198 of the 692 (29%) samples for which Germany submitted results contained quantifiable levels of 3-MCPD.

Many different analytical methods were used to measure 3-MCPD, resulting in a large number of limits of quantification. The highest value of 3-MCPD of 158 mg/kg was in a soy sauce sample (group 12.6.4.13). This group accounted for 249 of the 692 analysis results provided. However, the mean 1 value for this group (4.73 mg/kg) was less than the overall mean 1 value of 6.84 mg/kg for the whole 12.6.4 group. Group 12.6.4.6 (mushroom soy sauce) with a mean 1 value of 25.9 mg/kg made a significant contribution to the overall group 12.6.4 mean 1 and mean 2 values of 6.84 and 1.09 mg/kg respectively. 33 of the 55 mushroom soy sauce samples analysed contained 3-MCPD levels above 10 mg/kg.

3.3.1.6. Ireland

47 of the 178 (26%) samples for which Ireland submitted results contained quantifiable levels of 3-MCPD.

Of all the data collected during the task Ireland submitted the result with the highest level of 3-MCPD, this was for a light soy sauce sample (group 12.6.4.4). with a 3-MCPD level of 1779 mg/kg. Group 12.6.4.4 contained 14 samples with 3-MCPD levels above 10 mg/kg from a total of 42 analysed, giving mean values of 62.1 mg/kg. Again, mushroom soy sauce (group 12.6.4.6) also made a significant contribution to the overall mean values, with mean values of 23.2 mg/kg. The results from these groups made a significant contribution to the overall mean 1 and mean 2 value of 18.3 mg/kg.

3.3.1.7. The Netherlands

77 of the 273 (28%) samples for which The Netherlands submitted results contained quantifiable levels of 3-MCPD.

The highest level of 3-MCPD of 151 mg/kg was observed for a soy sauce sample (group 12.6.4.13). This group accounted for 139 of the 273 samples analysed and had a mean 1 value of 7.12 mg/kg. Group 12.6.4.6 (mushroom soy sauce) also contributed significantly to overall 3-MCPD levels with 4 out of 22 samples containing 3-MCPD levels above 10 mg/kg, the maximum containing 108 mg/kg. The overall mean 1 and mean 2 values were 5.20 and 5.25 mg/kg respectively.

3.3.1.8. Norway

47 of the 51 (92%) samples for which Norway submitted results contained quantifiable levels of 3-MCPD.

Almost all (49 out of 51) of the results provided were for soy sauce (12.6.4.13), only 4 of these did not contain quantifiable levels of 3-MCPD. 20 of the 51 samples (39%) contained 3-MCPD levels of 10 mg/kg or greater. The highest 3-MCPD level observed was 146 mg/kg. Both overall mean 1 and mean 2 values were 20.1 mg/kg.

3.3.1.9. Sweden

31 of the 76 (41%) samples for which Sweden submitted results contained quantifiable levels of 3-MCPD.

Values for dark soy sauces (group 12.6.4.2), light soy sauces (group 12.6.4.4) and mushroom soy sauces (group 12.6.4.6) contributed significantly to the overall mean 1 value of 5.41 mg/kg, with group 12.6.4.4 containing the highest individual level of 3-MCPD (79.9 mg/kg). The mean 1 values for groups dark, light and

mushroom soy sauces were 18.1, 22.7 and 7.60 mg/kg respectively. In contrast, only two samples out of 40 in group 12.6.4.13 (soy sauce) contained over 1 mg/kg of 3-MCPD, contributing to a mean 1 value of 0.460 mg/kg for this group. The overall mean 1 and mean 2 values were 5.41 and 5.42 mg/kg respectively.

3.3.1.10. UK

65 of the 170 (38%) samples for which the UK submitted results contained quantifiable levels of 3-MCPD.

Group 12.6.4.13 (soy sauce) had the greatest number of samples (47 of the 170), 9 of these 47 samples contained 3-MCPD levels above 10 mg/kg. Additionally, 3 of the 7 seasoning sauce (group 12.6.4.11) samples contained levels of 3-MCPD above 10 mg/kg. The seasoning sauce group mean 1 value of 31.6 mg/kg is the highest of all the groups sampled in the UK , the highest level in this group and in the overall UK data being 93.1 mg/kg. The overall mean 1 and mean 2 values were 3.45 and 3.46 mg/kg respectively.

3.3.1.11. Country of Origin

Table 4 summarises the 3-MCPD levels found in soy sauce and related products (group 12.6.4) by the product's country of origin (as labelled). The majority of samples of soy sauce and related products were from China (including Hong Kong) (741 samples, 40%) and Thailand (245 samples, 12%), with 393 of 2035 samples being from an unknown country of origin. The highest individual 3-MCPD level found in soy sauce was for a sample originating in China (1779 mg/kg).

The proportion of samples from a given country which contained quantifiable levels of 3-MCPD varied from 100% for the 19 samples from Vietnam to 9-10% for the 11, 73 and 94 samples from France, Germany and Singapore respectively.

It can be seen from the breakdown in table 4 that the distribution of contamination in products differs for countries of origin. Products from China (not including Hong Kong), Thailand and Vietnam had the highest mean 3-MCPD levels, with respectively 51, 61 and 95% of samples with quantifiable levels of 3-MCPD containing levels of 3-MCPD above 10 mg/kg.

Although only 19 samples originating from Vietnam were tested, it is worth noting that all but 1 of these contained levels of 3-MCPD over 10 mg/kg resulting in a mean 1 and mean 2 of 198 mg/kg.

Only countries where more than 10 samples have been analysed were considered in the above assessment.

3.3.2. Occurrence of 2-MCPD in soy sauce and soy sauce based products (group 12.6.4)

Only 55 of the 2035 soy sauce samples analysed for 3-MCPD were also analysed for 2-MCPD (table 1). Of these, 25 (45%) contained quantifiable levels of 2-MCPD. Results were limited to 5 different soy sauce categories. The highest level of 2-MCPD was 12.0 mg/kg in a sample of mushroom soy sauce (group 12.6.4.6). Overall mean 1 and mean 2 values were 1.79 and 1.80 mg/kg respectively (table 5).

Table 6 compares levels of 2-MCPD with levels of 3-MCPD, where quantifiable amounts of both have been measured in the same sample to give a ratio of 3-MCPD to 2-MCPD. With the exception of one 1997 result from the UK, 2-MCPD levels are much lower than the corresponding 3-MCPD levels. The range of these ratios is small (5:1 – 14:1) and compares favourably with previously quoted ratios of approximately 10:1 in HVP[8]. Only one sample (not shown in table 6) with a quantifiable level of 3-MCPD (0.050 mg/kg) which was also analysed for 2-MCPD did not contain any quantifiable 2-MCPD. The remaining 29 samples did not contain quantifiable levels of either 2-MCPD or 3-MCPD.

3.3.3. Occurrence of 1,3-DCP in soy sauce and soy sauce based products (group 12.6.4)

282 of the 2035 soy sauce and related samples analysed for 3-MCPD were also analysed for 1,3-DCP (table 1). The majority of these were supplied by Germany (114 in total; 27 with quantifiable levels), and the UK (123 in total; 24 with quantifiable levels). Additional data were supplied by Austria (10 in total; 1 with a quantifiable level) and Finland (35 in total; 8 with quantifiable levels). In all, just over 20% of the 282 analysed samples contained quantifiable levels of 1,3-DCP. The maximum amount of 1,3-DCP found in any of the samples was 1.37 mg/kg. Overall mean 1 and mean 2 values were 0.070 and 0.092 mg/kg respectively (table 5).

All samples containing 1,3-DCP also contained quantifiable levels of 3-MCPD. Table 7 shows the ratios of 1,3-DCP to 3-MCPD where quantifiable amounts of both have been measured in the same sample. The range of ratios is very wide (2:1 – 3630:1). However, it can be seen that levels of 1,3-DCP are always lower than the corresponding level of 3-MCPD. At 3-MCPD levels at or below 0.02 mg/kg, 1,3-DCP was quantified in only one sample at a level of 0.006 mg/kg. Table 8 shows samples where quantifiable amounts of 3-MCPD were found but where no 1,3-DCP was detected or was below the LOQ. From tables 7 and 8 it can be seen that 1,3-DCP was not detected in any sample containing a level of 3-MCPD of 0.02 mg/kg or below. The remaining 157 samples did not contain quantifiable levels of either 1,3-DCP or 3-MCPD.

3.3.4. Occurrence of 2,3-DCP in soy sauce and soy sauce based products (group 12.6.4)

The same samples analysed for 1,3-DCP by Austria and Finland were also analysed for 2,3-DCP. The UK (23 samples) and Germany (48 samples) provided additional data, with the German data yielding 10 samples containing quantifiable levels (max 0.2 mg/kg; mean 1 = 0.028 mg/kg). Of the samples analysed, 16% contained quantifiable levels of 2,3-DCP (table 1) and the overall mean 1 and mean 2 values were 0.013 and 0.028 mg/kg respectively (table 5).

All samples with quantifiable levels of 2,3-DCP also contained quantifiable levels of 3-MCPD. As with 1,3-DCP, an extremely wide range of ratios of 2,3-DCP to 3-MCPD can be seen (table 9), ranging from 56:1 to 6330:1. The lowest level of 3-MCPD at which 2,3-DCP was detected was 0.556 mg/kg, where the level of 2,3-DCP was 0.010 mg/kg. 2,3-DCP was not quantified in any samples where levels of
3-MCPD were less than 0.556 mg/kg (table 9). Again, levels of 2,3-DCP are always appreciably lower than 3-MCPD levels in the same sample.

3.4. Occurrence of chloropropanols in foods other than soy sauce

Table 11 summarises the chloropropanol occurrence data provided by participants for all foods except soy sauce (group 12.6.4). Tables giving details of the occurrence of chloropropanols in individual samples of foods other than soy sauce are given in tables 28-31. It is assumed that none of the reported chloropropanol analyses results have been corrected for dry matter content.

No data was provided for group 3 (edible ices including sherbet and sorbet) or group 10 (egg and egg products). Table 12 breaks down the 3-MCPD data in this summary table by food type to provide more detailed information. Data set A (the original data set) and data set B (which comprises data set A plus additional results submitted later in the task) are included in both tables so numbers of samples and foods tested can be compared. These data sets were used by participants to estimate 3-MCPD intakes. Table 13 provides a breakdown of 3-MCPD occurrence data by participant. Table 14 provides a breakdown of the limited occurrence data for the other three chloropropanols (2-MCPD, 1,3-DCP and 2,3-DCP) for all foods except soy sauce. Data set B has been used for the following observations:

3.4.1. Group 1: Dairy

In total, data for 3-MCPD analysis of 137 dairy samples were submitted (table 12). The UK provided the majority of the data for 3-MCPD (128 results) with Germany (1 result), Norway (7 results) and Sweden (1 result) providing the rest.

The mean 1 and mean 2 averages were 0.002 and 0.007 mg/kg respectively, reflecting the fact that only 11 (all cheese samples) of the 137 dairy samples analysed contained quantifiable levels of 3-MCPD. The maximum level of 3-MCPD found was 0.095 mg/kg, in a sample of cheese.

A total of 7 results were also provided for 2-MCPD (table 14). Only 1 sample (cheese) contained quantifiable levels of 2-MCPD (0.095 mg/kg)

3.4.2. Group 2: Fats, oils and fat emulsions

Only 2 countries (UK and Finland) provided 3-MCPD data. The 16 sample results from Finland related to oil samples from instant noodles; 12 of these samples contained quantifiable levels of 3-MCPD with a mean of 0.244 mg/kg and a maximum of 1.50 mg/kg (table 13). Other ingredients in these instant noodle oil samples are not known. The data supplied by the UK were mainly from fat emulsions and contained 2 samples with quantifiable levels of 3-MCPD, both of which were close to the limit of detection of 0.01 mg/kg. The high proportion of positive samples in the Finnish data resulted in mean 1 and mean 2 values of 0.087 and 0.090 mg/kg respectively (table 12).

3.4.3. Group 4: Fruit and vegetables

Only 2 countries (UK and Sweden) provided 3-MCPD data (37 samples in all) and this related to processed fruit and vegetables only. No 3-MCPD was detected in the 4 samples of processed fruit. However, 23 of the 33 results for processed vegetables contained quantifiable levels of 3-MCPD (mean = 0.095 mg/kg; max = 0.69 mg/kg) (table 12). The Swedish data accounted for 22 of these positive samples and 18 of these were results from analysis of processed garlic. Therefore the reported mean 1 (0.059 mg/kg) and mean 2 (0.61 mg/kg) values may not be representative of fruit and vegetables as a whole.

Only 2 analysis results (UK) were provided for 2-MCPD and neither identified a quantifiable level of this chloropropanol.

3.4.4. Group 5: Confectionery

All 39 analysis results were provided by the UK with only 3 samples containing quantifiable levels of 3-MCPD (max = 0.023 mg/kg). The mean 1 and mean 2 values were 0.002 and 0.006 mg/kg respectively.

The single analysis result for 2-MCPD (table 14) did not identify a quantifiable level of this chloropropanol.

3.4.5. Group 6: Cereals and cereal products

Five countries (Denmark, Finland, France, Norway and the UK) provided contributions with a total of 203 samples analysed (table 12). Of the 53 sample results containing quantifiable levels of 3-MCPD, 49 of these were from the 142 Finnish results analysing instant noodles. The remaining 4 results that contained quantifiable levels (max = 0.029 mg/kg) were UK data for chlorine bleached flour. The mean 1 and mean 2 values for 3-MCPD were 0.020 and 0.024 mg/kg respectively.

The UK also provided other chloropropanol data. 11 of the 12 samples analysed for 2-MCPD (table 14) originated from analysis of flours and 3 of these (chlorine-bleached flours) contained quantifiable levels of 2-MCPD, with a maximum of 0.015 mg/kg. No quantifiable amounts of 1,3-DCP and 2,3-DCP were found in either of the 2 flour samples analysed for these chloropropanols.

3.4.6. Group 7: Bakery wares

The UK (177 samples), France (120 samples) and Sweden (40 samples) provided 3-MCPD data. 173 of the 337 samples analysed (51%) contained quantifiable levels of 3-MCPD. Crackers (group 7.1.2) had the highest percentage of samples with quantifiable levels (47 of the 54 samples tested, 87%) with a maximum 3-MCPD value of 0.13 mg/kg. Crackers, other bakery products (group 7.1.3; 50 samples) and cakes (group 7.2.1; 43 samples) all had mean 1 values less than 0.03 mg/kg. The highest individual 3-MCPD value within bakery wares was 0.21 mg/kg and was one of 8 samples with quantifiable levels of 3-MCPD from 10 analyses of French fruitcake mix. Mean 1 and mean 2 values for the whole food group were 0.018 and 0.02 mg/kg respectively.

The UK also contributed 9 results for 2-MCPD with no samples containing quantifiable levels.

3.4.7 Group 8: Meat and meat products

No fresh meat or poultry results were submitted, all the data collected are representative of processed or treated meat/meat products. 56 of the 153 samples contained quantifiable levels of 3-MCPD, 49 of these 56 were analysed in the UK. This reflects the fact that the UK provided the majority (135) of the 153 results of 3-MCPD analyses, with Norway (10 results), Denmark (4 results) and Sweden (4 results) providing the rest.

Of the positive values from the UK, the highest was that for edible casings (group 8.4) where a 3-MCPD level of 219 mg/kg was reported. However, it should be noted that this result was from 1997 data. None of the Norwegian analysis results (sausage, ham, salami) contained quantifiable levels of 3-MCPD, whereas

all 4 of the Danish analysed samples (sausages) did (mean = 0.033 mg/kg). Of the 4 sample results from Sweden, 3 contained quantifiable levels of 3-MCPD (mean 1 and mean 2 = 0.190 mg/kg), though Sweden did not include edible casings in their analysed samples. Due to the high levels of 3-MCPD reported for samples including edible casings, the mean 1 and mean 2 values were both 1.47 mg/kg. Omitting the edible casing results gives a lower mean 1 value of 0.014 mg/kg and a mean 2 value of 0.018 mg/kg for meat and meat products.

Results for 2-MCPD showed 3 samples containing quantifiable levels, giving mean 1 and mean 2 values of 0.008 and 0.012 mg/kg respectively. 7 of these samples (continental sausage (5), stewed steak (1) and corned beef (1)) were also analysed for 1,3-DCP and 2,3-DCP. These samples had no quantifiable levels of any of the chloropropanols. 9 of the edible casing samples were also analysed for 1,3-DCP. Two of these samples contained quantifiable levels of 1,3-DCP of 0.5 and 1.5 mg/kg. These two samples also contained quantifiable levels of 3-MCPD (1.80 and 1.60 mg/kg respectively).

3.4.8. Group 9: Fish and fish products

Norway, Sweden and the UK provided data, with 51 of the 60 analysis results originating from the UK. The highest 3-MCPD levels were observed for hot smoked fish (group 9.4.3), with 6 out of the 7 samples analysed containing quantifiable levels of 3-MCPD (max = 0.191 mg/kg). Overall mean 1 and mean 2 values were 0.009 and 0.013 mg/kg respectively.

The UK also provided data on levels of 2-MCPD, 1,3-DCP and 2,3-DCP for samples of fish in oil (6 results), brine (4 results), mayonnaise (1 result) and tomato (3 results). Only 1 sample contained a quantifiable level of 2-MCPD and another single sample contained a quantifiable level of 2,3-DCP, though the level of 0.043 mg/kg for 2,3-DCP was not confirmed using ion ratios. None of the samples contained quantifiable levels of 1,3-DCP. A further 9 fish samples were analysed for 2-MCPD with no quantifiable levels being identified.

3.4.9. Group 11: Sweeteners including honey.

Only one sample (carbonated glucose from the UK) was analysed and did not contain 3-MCPD above the level of quantification.

3.4.10. Group 12: Salts, spices, soups and sauces (EXCLUDING SOY SAUCE)

Due to the similarities between these foods and soy sauce, a large number of analysis results (454) were generated for levels of 3-MCPD. All but one of the participants contributed sample results to this group, with the majority of the data

coming from Finland (187 samples; 139 with quantifiable levels), Sweden (80 samples; 50 with quantifiable levels), Germany (64 samples; 2 with quantifiable levels) and the UK (62 samples; 3 with quantifiable levels). Seasoning for instant noodles (included in group 12.2) accounted for 128 of the samples with quantifiable 3-MCPD levels supplied by Finland and 19 of those from Sweden. The highest 3-MCPD level in group 12.2 (Herbs, spices, seasonings and condiments) was a Finnish result of 8.50 mg/kg from a spice mixture for pork. 167 of the 230 samples for group 12.2 contained quantifiable 3-MCPD levels, resulting in mean 1 and mean 2 values of 0.249 and 0.251 mg/kg respectively. By contrast, only 6 out of 41 soup samples (group 12.5) contained quantifiable levels of 3-MCPD.

All 16 positive samples for 3-MCPD in group 12.6 (sauces and like products) that had not been classified into sub groups, originated from Sweden and were mainly from marinade samples. The highest 3-MCPD concentration (0.19 mg/kg) was found in a sample of oriental marinade from Sweden. In group 12.6.2 (non-emulsified sauces), a high result of 50.7 mg/kg (from Ireland) together with another result of 3.70 mg/kg (from Denmark) pushed the mean 1 value for this particular food group to 0.623 mg/kg.

A large proportion of the many instant noodle seasoning sample results had quantifiable levels of 3-MCPD and this together with other isolated high 3-MCPD levels resulted in the mean 1 and mean 2 values for group 12 being 0.252 and 0.286 mg/kg respectively.

The UK also provided data for 2-MCPD (20 samples), 1,3-DCP (10 samples) and 2,3-DCP (6 samples), none of which contained chloropropanol levels above the limit of quantification.

3.4.11. Group 13: Foodstuffs intended for particular nutritional uses

Only 4 dietetic food sample results (France) were provided. All contained 3-MCPD at quantifiable levels with a mean of 0.030 mg/kg.

3.4.12. Group 14: Beverages, excluding dairy products

The UK provided 125 analysis results, with Germany providing an additional 6 results. The only alcoholic drink tested was beer and the other results were limited to coffee, tea and malted drinks. None of the coffee, tea and malted drink samples (as consumed) contained quantifiable levels of 3-MCPD. 8 of the 100 beer samples (groups 14.2.1) contained quantifiable levels of 3-MCPD, though the levels were only slightly above the limit of quantification of 0.01 mg/kg (max = 0.017 mg/kg).

Coffee and tea samples were also analysed for 2-MCPD but none contained levels of the chloropropanol above the limit of quantification.

3.4.13. Group 15: Ready to eat savouries

Only 23 results were supplied for 3-MCPD levels by Denmark, France, Norway and the UK, corresponding to results from snack foods (21 in total; 7 with quantifiable levels) and processed nuts (2 in total; 1 with a quantifiable level). Mean 1 and mean 2 values were 0.007 mg/kg and 0.010 mg/kg respectively.

Neither of the 2 processed nut samples analysed for 2-MCPD contained quantifiable levels.

3.4.14. Group 16: Composite foods

All data were provided by the UK and 5 samples from a total of 24 contained quantifiable levels of 3-MCPD. Mean 1 and mean 2 values were 0.009 mg/kg and 0.013 mg/kg respectively.

3.5. Occurrence of chloropropanols in food ingredients

Table 15 summarises occurrence data provided by participants for all food ingredients. Table 16 breaks down the 3-MCPD data in this summary table by food ingredient type to provide more detailed information. Table 17 provides a breakdown of 3-MCPD data by participant. Table 18 provides a breakdown of the limited occurrence data for the three other chloropropanols (2-MCPD, 1,3-DCP and 2,3-DCP) for food ingredients. These data were not used by participants to estimate dietary 3-MCPD intakes.

Tables giving details of the occurrence of chloropropanols in individual samples of food ingredients are given in tables 32-35. It is assumed that none of the sample results have been corrected for dry matter content.

From the few data points for groups 17 (breadcrumbs), 18 (caramel) and 19 (gelatine), only one sample (group 17) contained a quantifiable level of 3-MCPD (0.014 mg/kg). A further 2 samples from group 26 (other) contained quantifiable levels of 3-MCPD. None of the yeast extract (group 24) samples contained any quantifiable amounts of 3-MCPD or 2-MCPD. The majority of the 3-MCPD data provided corresponds to samples of hydrolysed vegetable protein (HVP) and malts and these, along with the remaining groups, are discussed below.

3.5.1. Group 20: HVP

HVP is a savoury food ingredient used in processed and pre-prepared foods, soups, gravy mixes and savoury snacks, with typical levels ranging from 0.1% to 0.8% in such foods[11]. The UK (100) and Germany (30) contributed the bulk of the HVP sample results. Acid HVP accounted for 56 of the 146 HVP 3-MCPD analysis results (table 15) and the mean 1 value for this particular ingredient was 0.068 mg/kg (table 16). Enzyme HVP had a much lower mean 1 value (0.005 mg/kg) though only 15 results were provided. Just over half of the results for HVP were from samples where the hydrolysis method was unknown. This sub-group included the sample of HVP with the highest level of 3-MCPD (1.84 mg/kg) and had a mean 1 value of 0.047 mg/kg.

The UK also provided 2-MCPD data for acid HVP samples (with some of unknown type) and these levels were frequently greater than the corresponding 3-MCPD levels. However it must be noted that the 2-MCPD was measured semi-quantitatively in these samples. No data were provided for 1,3-DCP or 2,3-DCP.

3.5.2. Group 21: Meat extract

A total of 16 samples results were provided by Norway (7 samples), the UK (5 samples) and Denmark (4 samples). Of these, 5 contained 3-MCPD above the level of quantification, 3 of which were provided by Denmark (table 17). These were all broths and included the sample with the highest level of 3-MCPD (0.55 mg/kg). Overall mean 1 and mean 2 values were 0.060 and 0.064 mg/kg respectively.

3.5.3. Group 22: Malts

The quantity of malts used in foods such as cereal products, beers and malted milk drinks is in the range of 1 – 10%[9]. Only the UK (58 sample results) and Sweden (5 sample results) provided data. The highest individual 3-MCPD level was 0.85 mg/kg in a sample of malt extract. Over half (60%) of malt extract (group 22.2) samples contained quantifiable levels of 3-MCPD (table 15). This sub-group also had the highest mean 1 value of 0.125 mg/kg of all the malt sub-groups (table 16). The overall mean 1 value for group 22 was 0.093 mg/kg. This was the highest of all the food ingredients.

Data were also provided for 2-MCPD (table 18), where 10 (out of 17) samples of malt extract and a further 9 (out of 16) samples of unknown malt type contained quantifiable levels (max = 0.357 mg/kg). Only 3 out of 24 samples contained quantifiable levels of 1,3-DCP and just 1 sample of malt extract contained a quantifiable level of 2,3-DCP (0.02 mg/kg).

3.5.4. Group 23: Modified starches

Only 2 of the 9 samples provided by the UK contained a quantifiable level of 3-MCPD, the highest of which was 0.488 mg/kg. Both of these samples were maize yellow dextrin as neither white dextrin nor acid-treated starches had quantifiable levels. The mean 1 and mean 2 values were 0.056 and 0.059 mg/kg respectively. Neither of the 2 samples tested for 2-MCPD contained quantifiable levels.

3.5.5. Group 25: Seasonings

In total, 15 samples were analysed for 3-MCPD and 4 of these contained quantifiable levels, the highest being 0.06 mg/kg. All of the sample results for this group were provided by Denmark (table 17).

4. INTAKE OF CHLOROPROPANOLS IN FOOD

4.1. 3-MCPD Dietary intake

In order to obtain an indication of dietary intakes of 3-MCPD in the participating countries, each participant used their own national system for exposure estimates. References to the different methods used to estimate 3-MCPD intake including the number of subjects in the study, average body weights, and references are given in table 19. All participating countries except Austria and Norway provided intake data. Participants used different occurrence data sets to calculate 3-MCPD intake. Denmark, Finland and Sweden used data set A to estimate 3-MCPD intake in foods other than soy sauce. Data set A was the original data sent to participants. France, UK, The Netherlands, Germany and Ireland all used occurrence data set B, which included additional occurrence data.

Consistent with the consumption data provided, most countries (all except Germany) calculated the best estimates for the adult population. It should be noted that, as well as using different methods for calculating consumption, participants also used different methods of calculating intakes. In addition to adult population data, some countries also provided intake data for other specific sub-groups. France, UK, Ireland, The Netherlands, Sweden and Germany all supplied data for adult consumers. France, The Netherlands and UK supplied data for both the child population as well as for just consumers, with Germany providing data on only the latter.

For the purpose of dietary intake estimates, population consumption is the average of consumption of a food across all people surveyed i.e. takes into account those who don't eat the food, whereas consumer consumption is the average amongst only those who actually eat the food.

4.2. Best estimate of the dietary intakes

In general, on the basis of the data provided, four different estimates of dietary intakes from each food commodity, as derived by the combination of the above sets of data were agreed upon:

- Mean food consumption and mean 1 occurrence data
- Mean food consumption and mean 2 occurrence data
- 95th percentile food consumption (if available) and mean 1 occurrence data
- 95th percentile food consumption (if available) and mean 2 occurrence data

See section 3.1 for an explanation of mean 1 and mean 2.

Some countries were unable to supply either one or more of these four dietary estimates. The intake estimates were calculated on a per person and per kg of body weight (bw) basis, the latter being calculated on the bw values (table 19) supplied by participants.

4.3. Total dietary intake in participating countries

The estimates of total dietary 3-MCPD intake on a population basis for adults and children are summarised in table 20. Intake results have been broken down by country and by food group for both adults (table 21) and children (table 22). The intake results have also been given on a population and consumer basis where information was available.

4.3.1. Adults

The best estimates of total dietary 3-MCPD intakes for adults on a population basis are significantly less than the EC's Scientific Committee on Food's Tolerable Daily Intake (TDI) of 2 µg/kg bw/day for all participants who provided data (table 20). The highest value reported was the mean 2 95%ile intake for adults in the Netherlands (1.38 µg/kg bw/day).

In terms of contribution from individual foods, a high proportion of the adult population 3-MCPD intake for Finland was due to soy sauce (0.140 of 0.200 µg/kg bw/day (mean 1)) (table 21). In contrast, soy sauce contributed less to overall 3-MCPD intake in other countries such as France, Sweden and Denmark due to low consumption and low mean occurrence levels. Instead, other food groups made significant contributions to 3-MCPD intake. For example in Denmark, consumption of bread (group 7.1.1.1 – 4) contributed over a third to 3-MCPD intake. In the Netherlands, non-emulsified sauces (group 12.6.2) contributed a greater proportion to 3-MCPD intake in the adult population than soy sauce. In both the UK and Ireland, intake of 3-MCPD was greatest from sauces and like products (group 12.6).

In general, within estimated population intakes, other food groups which contributed significantly to 3-MCPD intakes in adults include bread, meat, and beer. High consumption values rather than high occurrence levels of 3-MCPD were the primary reason for this.

Estimated dietary intakes of 3-MCPD for consumers in participating countries are again significantly less than the TDI of 2 µg/kg bw/day. Estimated 3-MCPD intakes for consumers of soy sauce ranged from 0.108 µg/kg bw/day (Germany, mean – mean 1) to 1.08 µg/kg bw/day (Ireland, 95%ile – mean 2) from this food alone (table 21). Sweden, UK and Germany all had low 3-MCPD intake estimates from soy sauce due to low intake and occurrence levels. However, as with all countries, intake of 3-MCPD was greatest from soy sauce when compared with any of the other food groups. France reported the highest mean intake of 3-

MCPD from soy sauce (mean 1 = 0.514 µg/kg bw/day) amongst consumers and this was due more to high consumption of soy sauce rather than high occurrence levels of 3-MCPD.

Other food groups that contributed significantly to 3-MCPD intake included other sauces, for example in Ireland where mean (mean 1 and mean 2) consumer values for sauces and like products (group 12.6) were 0.096 and 0.119 µg/kg bw/day respectively. Also in the Netherlands where mean (mean 1 and mean 2) intakes of 3-MCPD from non-emulsified sauces (group 12.6.2) were 0.217 and 0.248 µg/kg bw/day respectively. Again, foods consumed in high quantities e.g. pasta and noodles (group 6.4) and bread and rolls (7.1.1) also contributed significantly to intake of 3-MCPD.

4.3.2. Children

France, the Netherlands and the UK provided estimates of 3-MCPD in the child population (table 22). The total dietary intakes for this group were higher than the corresponding adult population estimates. As with the adult data, foods contributing most to 3-MCPD intakes on a population basis were those with high consumption such as bread, noodles and cakes. Non-emulsified sauces (12.6.2) and sauces (12.6) also contributed significantly to overall mean intakes of 3-MCPD within the child population, in the Netherlands and UK respectively.

With respect to child consumers however, 95%ile mean 2 estimated intakes of 3-MCPD from soy sauce were 1.66 µg/kg bw/day in France, 1.72 µg/kg bw/day in the Netherlands and 2.15 µg/kg bw/day in the UK. This indicates that children who consume high levels of soy sauce may have 3-MCPD intakes close to or exceeding the TDI of 2 µg/kg bw/day. Germany also supplied data on consumers for individual age groups of 4 and 14 year-olds. Although consumption of soy sauce was the same between the two age groups, mean 2 intake of 3-MCPD for the 95%ile in 4 year-olds was noticeably higher (1.70 µg/kg bw/day) due to the difference in body weights.

4.3.3. 0.02 mg/kg scenario

Much of the 3-MCPD occurrence data for 3-MCPD levels in soy sauce, on which the estimated intakes for this commodity were based, are the result of targeted sampling of soy sauce suspected of having high 3-MCPD levels. Also, the age of some of the samples means that industry practises to reduce 3-MCPD levels may well have been introduced since the analysis was carried out. Participants were therefore asked to provide an estimate of total dietary 3-MCPD intake when 3-MCPD levels in soy sauce were assumed to be 0.02 mg/kg (the current European limit)[5]. These additional estimates of total dietary 3-MCPD consumption from population data are summarised in table 23.

The estimated adult 3-MCPD intake on a population basis for Finland are two-thirds lower (mean, mean 1 values) when levels of 0.02 mg/kg for soy sauce is assumed. This reflects the high levels in soy sauce when actual occurrence data from Finland was used. Denmark, France, Sweden, Ireland, the Netherlands and the UK showed modest decreases in total adult population 3-MCPD intakes and all adult mean estimates were below 0.5 µg/kg bw/day. Mean (mean 1) intake of 3-MCPD amongst German consumers however, dropped substantially (0.123 µg/kg bw/day to 0.015 µg/kg bw/day), lowering the estimated intake of 3-MCPD to approximately 12% of its original value. This highlights the large proportion of 3-MCPD intake attributed to soy sauce within this group.

The mean child population intakes from France, UK and the Netherlands were also reduced when 0.02 mg/kg soy sauce levels were assumed. The reduction was slight however, underlining the fact that for some populations, soy sauce is not the major contributor to intake of 3-MCPD. Instead, other foods that are eaten in large quantities such as bread and noodles contribute more significantly to 3-MCPD intake.

Similarly to adults, lowering of intake of 3-MCPD amongst children is more pronounced when considering consumer consumption (Germany). For example, intake of 3-MCPD in 4 year-olds is reduced from 1.70 µg/kg bw/day to 0.314 µg/kg bw/day (95%ile, mean 2). Again, this emphasises the high levels of 3-MCPD in soy sauce when using national occurrence data as opposed to assumed levels of 0.02 mg/kg as well as the large contribution of soy sauce consumption to overall intake of 3-MCPD.

5. DISCUSSION

5.1. Occurrence

5.1.1. 3-MCPD

Results of analysis of 3-MCPD in over 3600 food samples have been collected and collated as part of SCOOP task 3.2.9. The majority (2035) of these are for soy sauce and soy sauce related products (group 12.6.4) and just over one-third of these products (714) contained quantifiable levels of 3-MCPD. The product group with the highest mean level of 3-MCPD within food group 12.6.4 was seasoning sauce (group 12.6.4.11) with mean 1 and 2 values of 40.9 mg/kg. Other groups with high mean occurrence levels are light soy sauce (group 12.6.4.4) with mean 1 and 2 levels of 15.3 and 15.4 mg/kg (233 samples) respectively and mushroom soy sauce (group 12.6.4.6) with mean 1 and mean 2 levels of 15.5 mg/kg (171 samples). The latter group also had the highest proportion of samples with quantifiable levels of 3-MCPD (59%). Overall, group 12.6.4 had significantly higher levels of 3-MCPD than any other food group (mean 1 = 9.06 mg/kg; mean 2 = 9.16 mg/kg).

However it is important to be aware that much of the soy sauce data was collected as the result of targeted sampling of soy sauce suspected of having high 3-MCPD levels. Additionally, it must be noted that some of the results date back to 1997 and soy sauce manufacturers have taken steps to reduce 3-MCPD levels in their products since this time. Therefore, some of the data collected may not represent the current levels of 3-MCPD in soy sauce. In spite of this, the wide range of values presented for 3-MCPD in soy sauce and related products, including a large number of values exceeding 10 mg/kg, mean that 3-MCPD levels in soy sauces should be continually monitored to ensure that levels do not present an unacceptable risk to public health.

SCOOP task 3.2.9 has also been particularly successful in collating data on 3-MCPD in foods other than soy sauce. 3-MCPD analysis results have been collected for over 1600 samples covering many of the major food groups such as dairy, meat, cereals and bakery products. The majority of the data collected (454 samples) is for food group 12 (salts, spices, soups, sauces, salads, protein products etc.), reflecting the interest in these products due to their similarities with soy sauce and the potential use of HVP as an ingredient in these savoury products. Just under half (45%) of samples from this group had quantifiable levels of 3-MCPD and the group had the highest mean levels of 3-MCPD (0.252 mg/kg) of the non soy sauce food groups, excluding meats. Meats (group 8) had a mean 1 and 2 3-MCPD level of 1.47 mg/kg, this was largely due to results from old data where edible casings contributed to high average 3-MCPD levels and was not indicative of the other meat samples. Similarly, the relatively high mean 1 and mean 2 values for fats and oils (group 2) of 0.087 and 0.090 mg/kg was largely due to oil samples from instant noodles analysed by Finland and may not

represent levels across the whole of oils and fats. This group also had a high proportion of samples with quantifiable levels of 3-MCPD (41%).

Other food groups for which there were a significant number of results included dairy products (group 1; 137 results) cereals and cereal products (group 6; 203 results), bakery wares (group 7; 337 results) and beverages (group 14; 131 results). In the case of the majority of the food groups other than soy sauce and related products, each had a high proportion of samples containing quantifiable levels of 3-MCPD. However, all of these groups had mean 1 3-MCPD values of 0.02 mg/kg or lower. It is perhaps important to note that for some food groups, the vast majority of the data was provided by only two to three participants. Variations in raw materials and processing conditions may mean that the true mean 3-MCPD occurrence levels across Europe may differ from the levels given in this report.

The ingredient group with the highest number of samples analysed for 3-MCPD was HVP (group 20, 146 of 295 ingredient samples). Over half the HVP samples labelled as acid-HVP (29 of 56 samples, 52%) contained quantifiable levels of 3-MCPD. The highest level of 3-MCPD detected was 1.84 mg/kg for an HVP sample of unknown production process. Mean 1 and mean 2 values for HVP were 0.051 and 0.171 mg/kg respectively. Malts (group 22) and particularly malt extracts (group 22.2) had higher mean levels of 3-MCPD than other ingredients. Indeed, 15 (60%) of the 25 malt extract samples analysed contained quantifiable levels of 3-MCPD. Approximately a quarter of meat extracts (group 21) and modified starches analysed contained quantifiable levels, though only 16 and 9 samples were analysed respectively. There was very little data available for the other ingredient groups had very few samples containing quantifiable levels.

5.1.2. Other chloropropanols

As with 3-MCPD, data corresponding to levels of 2-MCPD, 1,3-DCP and 2,3-DCP in foods were largely restricted to soy sauce and soy sauce related products. As with 3-MCPD, mushroom soy sauce (group 12.6.4.6), represented the group with the highest proportion of samples containing quantifiable levels of all the other chloropropanols, with 78% of samples containing quantifiable levels of 2-MCPD and 2,3-DCP (52%) and 77% of samples containing quantifiable levels of 1,3-DCP. The highest mean 1 and mean 2 values for group 12.6.4 are also for mushroom soy sauce at 7.00 and 7.01 mg/kg respectively (2-MCPD), 0.778 and 0.789 respectively (1,3-DCP) and 0.111 and 0.133 mg/kg respectively (2,3-DCP), all at a LOQ of 0.1 mg/kg.

Less data were available for foods other than soy sauce. Where analytical results were given, very few samples contained quantifiable levels of 2-MCPD, 1,3-DCP or 2,3-DCP. Indeed, no quantifiable levels were measured in any of the samples from group 12 (salts, spices, soups, sauces, salads, protein products etc.). The highest level of any of the other chloropropanols found in food groups other than

soy sauce was in a sample of edible casings (group 8.4), where the level of 1,3-DCP was found to be 1.5 mg/kg. Even fewer data were generated on ingredients. The majority of samples analysed for other chloropropanols were for 2-MCPD in HVP products, where 40% of acid-HVP products contained quantifiable levels of 2-MCPD. Of the malt extract samples, over 50% contained quantifiable levels of 2-MCPD.

Soy sauce sample results where chloropropanols other than 3-MCPD had been measured were used to investigate whether levels of other chloropropanols correlated to 3-MCPD levels in soy sauces. With the exception of one 1997 UK result, all 2-MCPD levels are lower than corresponding 3-MCPD levels. The range of ratios of 3-MCPD to 2-MCPD is small (5:1 – 14:1) indicating some correlation between these two chloropropanols. Only one sample tested for both 3-MCPD and 2-MCPD contained a quantifiable level of 3-MCPD (0.050 mg/kg) without any detectable level of 2-MCPD. The lowest level at which 2-MCPD was seen was 0.031 mg/kg, where 3-MCPD was detected at 0.202 mg/kg.

The range of ratios for 3-MCPD to 1,3-DCP and for 3-MCPD to 2,3-DCP were large, indicating that there is no direct correlation between 3-MCPD and 1,3-DCP or between 3-MCPD and 2,3-DCP in foods. The greatest number of soy sauce and related samples analysed for other chloropropanols was for 1,3-DCP (282 results). The lowest level of 3-MCPD at which 1,3-DCP was found was 0.020 mg/kg where the level of 1,3-DCP was 0.006 mg/kg. At levels of 3-MCPD below 0.02 mg/kg, 1,3-DCP was not detected in any of the samples. The lowest ratio of 3-MCPD to 2,3-DCP was 56:1 and no 2,3-DCP was detected in any samples containing 0.410 mg/kg 3-MCPD or less. Although there is some correlation between 3-MCPD and 2-MCPD, the lack of relationship between 3-MCPD and 1,3-DCP and between 3-MCPD and 2,3-DCP indicates that predictions regarding the levels of these chloropropanols in food when 3-MCPD levels are known, cannot be made. Importantly, no 2-MCPD, 1,3-DCP or 2,3-DCP were detected when 3-MCPD levels were below the European limit of 0.02 mg/kg.

Comparison of levels of 3-MCPD with levels of 2-MCPD, 1,3-DCP and 2,3-DCP was not conducted due to the lack of data for these chloropropanols in foods other than soy sauce.

5.2. Estimated Dietary Intake

The different methodologies used by each participant to collect consumption data, together with dietary variations between participating countries, resulted in a wide range of estimated population 3-MCPD intakes. However, all population 3-MCPD intake estimates were below the TDI of 2 µg/kg bw/day. The highest estimated population intakes were 1.38 µg/kg bw/day (mean 2 95%ile) for adults and 1.69 µg/kg bw/day (mean 2 95%ile) for children, both estimates were from the Netherlands. Soy sauce contributed significantly to population 3-MCPD intake in most countries, especially in Finland. However, it should be considered that

such results may be considered skewed since soy sauce consumption data for Finland was estimated from import statistics and in addition, levels of soy sauce from Finland were relatively high due to targeting of samples. Other foods that contributed most to population 3-MCPD intakes were those consumed in large volumes such as bread, meat, noodles and beer as well as other sauces from group 12.6.

Estimated dietary intakes of 3-MCPD from individual food groups amongst adult consumers were also below the TDI of 2 µg/kg bw/day, the highest estimate being 1.08 µg/kg bw/day (mean 2 95%ile) from Ireland for soy sauce and related products (group 12.6.4). Although intake of 3-MCPD amongst consumers was greatest from soy sauce for all countries, foods such as noodles, breads and other sauces also contributed significantly to 3-MCPD intake. For example, when looking at the mean 1, French population data, foods in the 'white bread & rolls' and 'pasta & noodles' food groups resulted in intakes of 0.021 µg/kg bw/day and 0.016 µg/kg bw/day respectively, compared with 0.013 µg/kg bw/day for soy sauce. Notably, consumer intake data shows that some children may have high 3-MCPD intakes from soy sauce alone, with UK estimates of up to 2.15 µg/kg bw/day (95%ile, mean 1 and mean 2). This suggests that high level consumers of soy sauce may be at risk of exceeding the TDI. However, these intakes were estimated using occurrence data that, due to targeted sampling and changes in industry practices, are likely to be an over-estimation of 3-MCPD intake from soy sauce. Other populations that are likely to be in the high risk group are those in East and South East Asian communities, who consume large quantities of soy sauce and related products, potentially containing high levels of 3-MCPD.

Using a scenario whereby levels of 3-MCPD in soy sauce were assumed to be 0.02 mg/kg all intakes of 3-MCPD were lower than the estimates based on the collected data. The most notable differences occurred for participants where 3-MCPD in soy sauce contributed greatly to the intake estimates. This is best exemplified for Finland, where overall intake of 3-MCPD in the adult population was approximately one-third lower when assuming levels of 0.02 mg/kg than the real intake estimates (from 0.200 µg/kg bw/day to 0.060 µg/kg bw/day for mean, mean 1). The effect of this 0.02 mg/kg scenario on estimated 3-MCPD intake was less pronounced in countries where consumption of soy sauce contributed less significantly to overall 3-MCPD intake or where the actual 3-MCPD levels in soy sauce was closer to the current EC limit of 0.02 mg/kg. This is well illustrated in the UK, where the average 3-MCPD level was 3.45 mg/kg (mean 1, UK). Use of the 0.02 mg/kg of 3-MCPD in soy sauce scenario resulted in a lowering of the estimated intake from 0.140 µg/kg bw/day to just 0.123 µg/kg bw/day for mean, mean 1 results.

For those countries that supplied data, child mean population intakes were also lowered. The lowering of overall mean intake of 3-MCPD was only small however, underlining the contribution of other food groups such as bread and noodles to 3-MCPD intake. The lower estimated intake levels for child consumers is more notable, as highlighted by estimates from Germany on 4 and 14 year-

olds. Intake values for both mean and 95%ile groups were greatly lower than those for the estimates based on the collected data. The same is true of adult data and this emphasises the fact that soy sauce contributes much more significantly to the overall intake of 3-MCPD when considering consumers, than it does when considering population data.

6. CONCLUSIONS

SCOOP task 3.2.9 has been successful in achieving its primary aim of collecting and collating information on the levels of 3-MCPD and other chloropropanols in a variety of different foods. A large amount of data has been collected, mainly on 3-MCPD in soy sauce and related products (2035 samples) but also for other foods (1637 samples). A smaller amount of information has also been collected on the occurrence of other chloropropanols in foods including soy sauce, namely 2-MCPD (170 samples), 1,3-DCP (324 samples) and 2,3-DCP (145 samples). The task has provided a comprehensive insight into 3-MCPD occurrence levels by examining the data from different perspectives, namely by individual food and ingredient types, by the country that provided the data and for soy sauce and soy sauce based products by the country of origin.

Levels of chloropropanols seen in soy sauce and soy sauce related products were much higher than those seen in any other food or ingredient group. However, it is important to emphasise that targeting of products suspected of containing high levels of 3-MCPD as well the age of some of the data (dating back to 1997) may not give a totally accurate reflection of the status of 3-MCPD contamination of foods in Europe at present.

Comparisons have also been made between levels of 3-MCPD and other chloropropanols. Although there is some relationship between levels of 3-MCPD and 2-MCPD given the narrow range of ratios, there is no direct relationship between 3-MCPD and 1,3-DCP or between 3-MCPD and 2,3-DCP. This suggests that it is not possible to predict levels of 1,3-DCP or 2,3-DCP in foods based on known levels of 3-MCPD. Importantly however, levels of 1,3-DCP and 2,3-DCP are always lower than the corresponding measurement of 3-MCPD, in more than half the samples 1,3-DCP was not quantified when 3-MCPD was detected, the ratio of 3-MCPD to 1,3-DCP varies greatly, ranging from 1:2 to 1:3630, similarly the ratio of 3-MCPD to 2,3-DCP ranged from 1:56 to 1:6330, where almost three quarters of samples analysed for 2,3-DCP did not contain quantifiable levels. Where quantified the level of 2-MCPD was always at least 5 times lower than that of the quantified 3-MCPD apart from one sample, from 1997. There also appears to be a level of 3-MCPD at which neither 1,3-DCP nor 2,3-DCP are detected and may therefore indicate a level of 3-MCPD at which 1,3-DCP and 2,3-DCP are not formed.

The second objective of this SCOOP task was to give an indication of the dietary intake of 3-MCPD. This was achieved successfully, although not all participants provided estimates. Some data was also missing for certain individual groups such as dietary intake of children or for 95%ile consumers. The mean estimates of total dietary intake are all below the TDI of 2 µg/kg bw/day, for both adults and for children. The highest estimated dietary intakes were 0.364 µg/kg bw/day (Ireland, mean 2) and 0.503 µg/kg bw/day (UK, mean 2) for adults and children respectively. Estimates for the 95%ile range, which represent the high risk group

are also generally well below 2 µg/kg bw/day. There is some evidence however, particularly for children, that those in the high risk group may have a dietary intake of 3-MCPD approaching the TDI and even exceeding it when considering consumption of soy sauce alone, as illustrated by UK data where mean 1 and mean 2 levels in the 95%ile range for child consumers were 2.15 µg/kg bw/day. The next closest levels to the TDI were seen in child consumers in the Netherlands, mean 2 levels in the 95%ile were 1.719 µg/kg bw/day for soy sauce and 0.821 µg/kg bw/day for non-emulsified sauces.

The main contributors of 3-MCPD to dietary intake were soy sauce and soy sauce based products. However, some other food groups also contributed significantly to intake and in some countries, these food groups contributed more significantly to overall intake of 3-MCPD. These foods included those eaten in large quantities such as breads and noodles and their contribution to intake can therefore be attributed to high consumption rather than particularly high levels of 3-MCPD present in the foods. For example, when looking at the mean 1, French population data, intakes from food groups 'white bread & rolls' and 'pasta & noodles' were 0.021 µg/kg bw/day and 0.016 µg/kg bw/day respectively, compared with 0.013 µg/kg bw/day for soy sauce. Other foods in group 12.6 such as non-emulsified sauces also contributed significantly to 3-MCPD intake and although consumption of these was greater than soy sauce, levels of 3-MCPD were not as high as in soy sauce.

In assuming a scenario whereby levels of 3-MCPD are 0.02 mg/kg in soy sauce, estimates of 3-MCPD dietary intake decreased. Those that are greatly lowered, for example in Finland (from 0.200 µg/kg bw/day to 0.060 µg/kg bw/day for mean, mean 1), reflect the large contribution made by soy sauce to the actual dietary intake estimates. For most countries, the overall estimates of 3-MCPD dietary intake are not greatly lowered (e.g. the UK, 0.140 µg/kg bw/day to 0.123 µg/kg bw/day for mean, mean 1), underlining the contribution made by other foods, such as breads, noodles and sauces other than soy sauce.

Although SCOOP task 3.2.9 has been successful in achieving its aims and objectives, improvements could be considered in some areas. Firstly, there are still some foods for which there is no or limited data. These foods include fresh fruit and vegetables, fresh meat, eggs, snack foods and composite foods. In addition, the only alcoholic beverage to be tested for 3-MCPD is beer. Although the likelihood of foods such as fresh fruit and vegetables containing significant levels of 3-MCPD is small, they could nevertheless be tested so that results from processed samples of these foods do not over estimate 3-MCPD levels.

In terms of the reliability of data, the following could be improved; standardisation of sampling plans and methods of analysis, number and type of analysed commodities, quality assurance of data, information on the role of technological processing on the fate of 3-MCPD. In consideration of the wide spectrum of methodologies used to calculate consumption data, the definition of guidelines aimed at improving the compatibility of methodology for gathering consumption

data could be useful. In addition, a more accurate assessment of exposure within Europe might be achieved by examining more closely specific groups of the population, such as those within specific age groups or ethnic diets.

Additional data based upon total diet or duplicate test portions could also be developed in order to overcome uncertainties due to many factors including non-representative sampling procedures as well as inaccurate consumption data.

ANNEX 1

Background Information on Chloropropanols

History

3-Monochloropropane-1,2-diol (3-MCPD) belongs to a group of chemicals called chloropropanols. Other chloropropanols include 2-monochloro-1,3-propandiol (2-MCPD), 1,3-dichloro-2-propanol (1,3-DCP) and 2,3-dichloro-2-propanol (2,3-DCP). These can be formed in foods as a result of processing conditions, though the mechanism for their formation is not fully understood.

In the 1980's it was found that the procedure used to manufacture acid hydrolysed vegetable protein (acid-HVP), the most widely used HVP, could generate small amounts of chloropropanols, the most common of which is 3-MCPD[10,11]. Since then it has been found to occur in several other foods and food ingredients as a result of processing, storage conditions or less frequently from migration from certain food contact materials. Acid-HVP is a savoury ingredient used in foods such as soups, prepared meals, savoury snacks, gravy mixes and stock cubes. Typical levels of use range from 0.1% to approximately 0.8% in these foodstuffs[11]. Chloropropanols have most noticeably been found in soy sauce[12].

Therefore, chloropropanols and particularly 3-MCPD have become an international issue affecting foods worldwide. The European limit for 3-MCPD in soy sauce and acid-HVP has been set at 0.02 mg/kg based on the liquid product containing 40% dry matter[5]. The regulation was formally adopted on 8 March 2001, and applied from 5 April 2002.

Mechanism of Formation

Acid-HVP is produced by treating proteins from vegetables, such as soya, with hydrochloric acid[13]. During this process, components of fats and oils in the starting materials may be chlorinated at high temperature to form chloropropanols. Although the formation mechanism for 3-MCPD in other foods is not fully understood it is thought that it can be formed via a number of pathways.

- Reactions between naturally present components of food.
- Reactions between component parts of food and chemicals used in the manufacture/packaging of food.
- Reactions resulting from the application of heat to food during processing.

The UK's Food Standards Agency is conducting a study of factors affecting the formation of 3-MCPD in foods and as part of this, a review paper on occurrence of 3-MCPD and related compounds in foods has been published[14].

Chloropropanols in food

Acid-HVP is a frequently used ingredient of savoury foods such as soups, prepared meals, savoury snacks, gravy mixes and stock cubes. 3-MCPD has also been found to occur in a range of other foods and ingredients, most notably in soy sauce [12,15]. 1,3-DCP has also been detected in acid-HVP[9,10] and soy sauce[12].

Domestic cooking and the effects of cooking on levels of 3-MCPD have shown elevated levels in formation in toasted bread, some grilled cheeses and fried batters[16]. Further research is required in order to investigate the effect of cooking on levels of 3-MCPD.

Other sources

In addition to the presence of 3-MCPD in food, very low levels of this substance may also be found in drinking water from upland areas in the UK. This is due to its presence as a contaminant of epichlorohydrin-linked cationic polymer resins in flocculants used for water purification in a small number of treatment plants. No data on chloropropanol levels in drinking water are available.

Toxicology of 3-MCPD

Studies have shown that 3-MCPD is carcinogenic in rats when given in high doses over prolonged periods. Two mutagenicity studies of 3-MCPD have been completed. In October 2000, the UK Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM)[17] assessed these new studies, and concluded that 3-MCPD can be regarded as having no significant genotoxic potential *in vivo.* The UK Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC)[18] reassessed their opinion in light of this new information and concluded that 3-MCPD was unlikely to present a carcinogenic risk to man, provided the exposure was 1000 times lower than the no observed effect level (NOEL) of 1.1 mg/kg bw/day for tumouricity. The Scientific Committee on Food (SCF) assessed data in May 2001 and concluded that 3-MCPD is not genotoxic. The Committee derived a Tolerable Daily Intake (TDI) for 3-MCPD of 2 µg/kg bodyweight[19].

Toxicology of 1,3-DCP and 2,3-DCP

In 1988, the EC SCF reviewed chloropropanols and 1,3-DCP in particular. After considering available data, it agreed that 1,3-DCP is a genotoxic carcinogen that causes cancer by directly damaging genetic material. The UK's COC first considered 1,3-DCP in 1991. They concluded that it would be prudent to regard it as a genotoxic carcinogen *in vivo.* Following this assessment, the FAO/WHO and JECFA concluded in 1993 that because of its carcinogenicity, 1,3-DCP is an undesirable contaminant in food and that levels should be reduced to as low as technologically achievable. The UK's COM and COC both considered 1,3-DCP in 2000 and concluded:

COM Statement[17]:
"The Committee concluded that it would be prudent to regard 1,3-DCP and 2,3-DCP as potentially genotoxic *in vivo* and agreed that both compounds should be tested for genotoxicity *in vivo* using the approach set out in the COM guidelines";

COC Statement[18]:
"It is prudent to assume that 1,3-DCP is a genotoxic carcinogen and that exposure to 1,3-DCP should be reduced to as low a level as technologically feasible".

Analytical Methodology

3-MCPD

A fully validated analytical method capable of measuring 3-MCPD in food and food ingredients at levels down to 0.010 mg/kg has been developed by a UK Government laboratory (Central Science Laboratory (CSL)). This method was validated by a collaborative trial with labs from the UK, Switzerland, Japan, the United States, The Netherlands and one lab from the European Commission as part of the previous SCOOP task 3.2.6. The limit of detection derived from separate in-house studies was estimated to be 0.005 mg/kg. The method was adopted First Action by AOAC International[20]. The results have shown that the method is satisfactory when used by analysts who are not familiar with the specific determination of 3-MCPD but who have had a period of training, familiarisation and practice. They also show that the method can be applied to a wide range of foods and ingredients without significant modification.

1,3-DCP

1,3-DCP can be measured by using an automated headspace procedure with gas chromatographic separation and mass spectrometric detection. The fully validated method is published and available[21].

It is recommended that Member States adopt these two validated methods for future analysis of 3-MCPD and 1,3-DCP respectively in foods.

ANNEX 2

Instructions for participants

Instructions for completion of forms

- Data should only be submitted for analyses conducted during or after 1997.
- You are asked to supply details of accreditation for the methods of analysis used, however data that has been obtained using an unaccredited method should still be submitted, together with details of the method used.
- All abbreviations used should be spelt out on first usage.
- Main tables, figures and summary from the reference can be copied and included in your submission.
- Additional information on any of the samples can be submitted as discussed at various points in these instructions, all papers should be labelled using the participant code (Annex 2) and use the sample code to distinguish which foods are being discussed.
- Values of LOD, LOQ and level of chloropropanol should be given in mg/kg to 3 significant figures.

Form A : FOOD

Occurrence data for food samples

Sample code (chloropropanol code/food code/participant code/sample no.). In order to assist in the collation of data please can you enter the chloropropanol code /the food code for the sample /the participant code /and then assign a four digit sample number e.g. for data supplied by France on 3-MCPD in a processed cheese sample which was the twentieth sample submitted by them a sample code of a/ 1.6.7/05/0020 would be assigned.

Food Group

Please assign the sample to a food group using the descriptions given in the 'Description' column of Annex 2. For the processed cheese sample the entry for this cell would read 'Dairy/Cheese/Processed cheese'.

Description of food

Any additional information that describes the product should be given here.

Reference to published work

Details of where the information contained in the table has been published/can be obtained.

Date sample obtained

Please supply details of when the sample was purchased/received in the format yyyy/mm/dd, e.g. for a sample purchased on the 3 May 2001 the date supplied would be 2001/05/03. If only the month and year are know the date would be 2001/05.

Date sample analysed
Please supply details of when the sample was analysed in the format in the same format as for the date the sample was obtained.

Composite/individual sample
Please indicate if the sample was a composite sample and indicate the number of individual products used to construct the composite (a). The nature of the composition sample should also be given (b). This should be in the format a/b (see table) e.g. for a sample made up of 10 breads from the same product batch the table entry should read 10/2.

	a		b
Individual sample	01		0
Composite sample	02 - 99	Mixed sub-samples	0
		All sub samples are the same product	1
		All sub samples are the same product & same batch (as identified by batch code)	2

Replicate
If a sample is a replicate of another sample give the sample code of the matching sample here. If these replicates are from the same batch prefix the sample code of the matching sample with 'x'.

Analytical method
Please reference the method used to analyse the sample. Details of the validation of method, reproducibility, repeatability, normal recovery range, correction for recovery etc. and the method accreditation & validation should be supplied as an additional paper for each method. Label such papers using the participant code (Annex 2) and a method number, e.g. if Austria supply data that have been obtained using three different methods of analysis these documents should be labelled M01/01, M01/02 and M01/03 and the code included in this column of the table.

Limit of detection (LOD)
The limit of detection for each method of analysis in the food matrix analysed should be given in the table and in the paper detailing the analytical method. The definition of old used also needs to be given in the method paper.

Limit of quantification (LOQ)
The limit of quantification for each method of analysis in the food matrix analysed should be given in the table and in the paper detailing the analytical method. The definition of LOQ used also needs to be given in the method paper.

Level of chloropropanol
Level of chloropropanol quantifiable by analysis of the food sample in mg/kg to 3 significant figures.

Evidence of quality assurance
Is the analytical laboratory accredited, does it participate in national or international proficiency test schemes? Please give a summary of details in the table, if you wish to supply any further details, please do so in the method paper.

Information requested if available

Country of Origin

Ingredients and Processing details
Such details may well be useful in assessment of the data collected. If it is available please summarise in the table.

Consumption
Any data on consumption of the analysed food commodity should be supplied here, any additional information on this area should be supplied as a supplementary paper. Label such papers as discussed in 'General' below.

Dry weight
If available please state the dry weight of the product.

Form B : INGREDIENTS
Occurrence data for samples of food ingredients

Sample code (chloropropanol code/ingredient code/participant code/sample no)
In order to assist in the collation of data please can you enter the chloropropanol code (Annex 1)/the ingredient code for the sample (Annex 2)/the participant code (Annex 3)/and then assign a four digit sample number. e.g. for data supplied by France on 3-MCPD in a brewing malt sample which was the fifth sample submitted by them a sample code of a/6.1/05/0005 would be assigned.

Ingredient Group
Please assign the sample to an ingredient group using the descriptions given in the 'Description' column of Annex 1. For the brewing malt sample the entry for this cell would read 'Malts/Brewing malts'.

Description of ingredient
Any additional information that describes the product should be given here, e.g. powder, known 'E number'.

Reference to published work
Details of where the information contained in the table has been published/can be obtained.

Date sample obtained
Please supply details of when the sample was purchased/received in the format yyyy/mm/dd, e.g. for a sample purchased on the 3 May 2001 the date supplied would be 2001/05/03. If only the month and year are know the date would be 2001/05.

Date sample analysed
Please supply details of when the sample was analysed in the format in the same format as for the date the sample was obtained.

Composite/individual sample
Please indicate if the sample was a composite sample and indicate the number of individual products used to construct the composite (a). The nature of the composition sample should also be given (b). This should be in the format a/b (see table) e.g. for a sample made up of 5 malts from the same product batch the table entry should read 5/2.

	a		b
Individual sample	01		0
Composite sample	02 - 99	Mixed sub-samples	0
		All sub samples are the same product	1
		All sub samples are the same product & same batch (as identified by batch code)	2

Replicate
If a sample is a replicate of another sample give the sample code of the matching sample here. If these replicates are from the same batch prefix the sample code of the matching sample with 'x'.

Analytical method
Please reference the method used to analyse the sample. Details of the validation of method, reproducibility, repeatability, normal recovery range, correction for recovery etc. and the method accreditation & validation should be supplied as an additional paper for each method. Label such papers using the participant code (Annex 2) and a method number, e.g. if Austria supply data that have been obtained using three different methods of analysis these documents should be labelled M01/01, M01/02 and M01/03 and the code included in this column of the table.

Limit of detection (LOD)

The limit of detection for each method of analysis in the food matrix analysed should be given in the table and in the paper detailing the analytical method. The definition of old used also needs to be given in the method paper.

Limit of quantification (LOQ)
The limit of quantification for each method of analysis in the food matrix analysed should be given in the table and in the paper detailing the analytical method. The definition of LOQ used also needs to be given in the method paper.

Level of chloropropanol
Level of chloropropanol quantifiable by analysis of the food sample in mg/kg to 3 significant figures.

Evidence of quality assurance
Is the analytical laboratory accredited, does it participate in national or international proficiency test schemes? Please give a summary of details in the table, if you wish to supply any further details, please do so in the method paper.

Information requested if available

Country of Origin

Ingredients and Processing details
Such details may well be useful in assessment of the data collected. If it is available please summarise in the table.

Known use and level of use of ingredient
Please give any details you have on what foods the ingredient is used in and at what level.

Consumption
Any data on consumption of the food commodities in which the ingredient is used should be supplied here, any additional information on this area should be supplied as a supplementary paper. Label such papers as discussed in the introduction to this paper.

Dry weight
If available please state the dry weight of the product.

Codes assigned to chloropropanols

Chloropropanol	Chloropropanol Code
3-MCPD	A
2-MCPD	B
1,3-DCP	C
2,3-DCP	D
Codes for other chloropropanols	E
(to be allocated during task by agreement	F
with task co-ordinators if necessary)	G
	H
	I
	J

Codes assigned to participants

Country	Country Code
Austria	01
Denmark	02
European Commission, DG JRC	03
Finland	04
France	05
Germany	06
Ireland	07
The Netherlands	08
Norway	09
Sweden	10
UK	11

Food Categorisation System

Code	Description
0	**Food in general, unless otherwise specified**
1	**Dairy products, excluding products of category 2**
1.1	Milk and dairy-based drinks
1.1.1	Milk and buttermilk
1.1.2	Milk, incl., sterilised and UHT goats milk
1.1.3	Buttermilk (Plain)
1.1.4	Dairy-based drinks, flavoured and/or fermented (e.g. chocolate, milk, cocoa, eggnog)
1.2	Fermented and renneted milk products (plain) excluding drinks
1.2.1	Fermented milks (plain)
1.2.2	Non heat-treated after fermentation
1.2.3	Heat-treated after fermentation
1.2.4	Renneted milk
1.3	Condensed milk (plain) and analogues
1.3.1	condensed milk (plain)
1.3.2	Beverage whiteners
1.4	Cream (plain) and the like
1.4.1	Pasteurised cream
1.4.2	Sterilised, UHT, whipping or whipped cream and reduced fat creams
1.4.3	Clotted cream
1.4.4	Cream analogues
1.5	Milk powder and cream powder (plain)
1.5.1	Milk and cream powder
1.5.2	Powder analogues
1.6	Cheese
1.6.1	Unripened cheese
1.6.2	Ripened cheese
1.6.3	Total ripened cheese, includes rind
1.6.4	Rind of ripened cheese
1.6.5	Cheese powder (for reconstitution; e.g., for cheese sauces).
1.6.6	Whey cheese
1.6.7	Processed cheese
1.6.8	Cheese analogues
1.7	Dairy-based desserts (e.g. ice cream, ice milk, pudding, fruit or flavoured yoghurt)
1.8	Whey and whey products, exc., whey cheese
2	**Fats and oils, and fat emulsions (type water-in-oil)**
2.1	Fats and oils essentially free from water
2.1.1	Butter oil, anhydrous milk fat, ghee
2.1.2	Vegetable oils and fats
2.1.3	Lard, tallow and fish oil, and other animal fats
2.2	Fat emulsions mainly of type water in oil
2.2.1	Emulsions containing at least 80% fat
2.2.2	Butter and concentrated butter
2.2.3	Margarine and similar products (e.g. butter-margarine blends)
2.2.4	Emulsions containing less than 80% fat (e.g. minarine)
2.3	Fat emulsions other than 2.2, incl. mixed and/or flavoured products based on fat emulsions.
2.4	Fat based desserts (exc.,. dairy based desserts)
3	**Edible ices, including sherbet and sorbet**
4	**Fruits and vegetables (incl. mushrooms & fungi, roots and tubers, pulses and legumes), and nuts & seeds.**
4.1	Fruit
4.1.1	Fresh fruit
	Untreated fruit
	Surface-treated fruit

Peeled or cut fruit

4.1.2 Processed fruit
4.1.2.1 Frozen fruit
4.1.2.2 Dried fruit
4.1.2.3 Fruit in vinegar, oil or brine
4.1.2.4 Canned or bottled (pasteurised) fruit
4.1.2.5 Jams, jellies, marmalades
4.1.2.6 Fruit-based spreads other than 4.1.2.5 (e.g. chutney)
4.1.2.7 Candied fruit
4.1.2.8 Fruit preparations, incl. Pulp and fruit toppings
4.1.2.9 Fruit-based desserts, incl. fruit-flavoured water-based desserts
4.1.2.10 Fermented fruit products
4.1.2.11 Fruit fillings for pastries
4.1.2.12 Cooked or fried fruit

4.2 Vegetables incl. Mushrooms & fungi, roots & tubers, pulses and legumes), and nuts & seeds
4.2.1 Fresh vegetables
Untreated vegetables
Surface-treated vegetables
Peeled or cut vegetables
4.2.2 Processed vegetables, and nuts and seeds
4.2.2.1 Frozen vegetables
4.2.2.2 Dried vegetables
4.2.2.3 Vegetables in vinegar, oil or brine
4.2.2.4 Canned or bottled (pasteurised) vegetables
4.2.2.5 Vegetable, and nut & seed purees and spreads (e.g. peanut butter)
4.2.2.6 Vegetable, and nut & seed pulps and preparations other than 4.2.2.5
4.2.2.7 Fermented vegetable products
4.2.2.8 Cooked or fried vegetables

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5 Confectionery

5.1 Cocoa products and chocolate products incl. limitations and chocolate substitutes
Cocoa mixes (powders and syrups)
Cocoa based spread, incl. fillings
Cocoa and chocolate products other than 5.1.1, 5.1.2 and 5.1.4 (e.g. milk chocolate bar, chocolate flakes, white chocolate)
Imitation chocolate, chocolate substitute products
5.2 Sugar based confectionery other than 5.1, 5.3 and 5.4, incl. hard and soft candy, nougats, etc.
5.3 Chewing gum
5.4 Decorations (e.g. for fine bakery wares), toppings (non-fruit) and sweet sauces.

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6 Cereals and cereal products, incl. flours & starches from roots & tubers, pulses & legumes, excluding bakery.

6.1 Whole, broken or flaked grain, incl. rice
6.2 Flours and starch
6.3 Breakfast cereals
6.3.1 Muesli
6.3.2 Maize based cereals
6.3.3 Rice based cereals
6.3.4 Wheat based cereals
6.3.5 Mixed grain cereals
6.3.6 Oat cereals
6.3.7 Other cereals
6.4 Pastas and noodles
6.5 Cereal and starch-based desserts (e.g. rice pudding, tapioca pudding)
6.6 Corn snacks
6.7 Batters (e.g. for breading or batters for fish or poultry)

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7 Bakery wares

7.1 Bread and ordinary bakery wares
7.1.1 Breads and rolls
7.1.1.1 White
7.1.1.2 Brown

7.1.1.3	Wholemeal
7.1.1.4	Rye
7.1.2	Crackers, excluding sweet crackers
7.1.3	Baked cereal products
7.1.3.1	Crispbread/crisprolls
7.1.3.2	Toasted bread (e.g., Melba toast)
7.1.3	Other ordinary bakery products (e.g. bagels, pita, English muffins)
7.1.4	Bread-type products, incl. bread stuffing & bread crumbs
7.2	Fine bakery wares
7.2.1	Cakes, cookies and pies (e.g. fruit-filled or custard types)
7.2.2	Biscuits
7.2.2.1	Malted biscuits
7.2.2.2	Rusks
7.2.2.3	Toasted biscuits
7.2.3	Other fine bakery products
	Doughnuts
	Others (e.g. sweet rolls, scones and muffins)
7.2.4	Mixes for fine bakery wares (e.g. cakes, pancakes)
8	**Meat and meat products, including poultry and game**
8.1	Fresh meat, poultry and game
8.1.1	Whole pieces or cuts
8.1.2	Comminuted
8.2	Processed meat, poultry and game products in whole pieces or cuts
8.2.1	Non-heat treated
8.2.1.1	Cured (incl. Salted)
8.2.1.2	Cured (incl. Salted) and dried.
8.2.1.3	Fermented
8.2.2	Heat-treated
8.2.3	Frozen
8.3	Processed comminuted meat, poultry and game products
8.3.1	Non-heat treated
8.3.1.1	Cured (incl. Salted)
8.3.1.2	Cured (incl. Salted) and dried
8.3.1.3	Fermented
8.3.2	Heat-treated
8.3.3	Frozen
8.4	Edible casings (e.g. sausage casings)
9	**Fish and fish products, including molluscs, crustaceans and echinoderms (MCE)**
9.1	Fresh fish and fish products, incl. MCE
9.1.1	Fresh fish
9.1.2	Fresh molluscs, crustaceans and echinoderms
9.2	Processed fish and fish products, incl. MCE
9.2.1	Frozen fish, fish fillets and fish products, incl. MCE
9.2.2	Frozen battered fish, fish fillets and fish products, incl. MCE
9.2.3	Frozen minced and creamed fish products, incl. MCE
9.2.4	Cooked and/or fried fish and fish products, incl. MCE
9.2.4.1	Cooked fish
9.2.4.2	Cooked molluscs, crustaceans and echinoderms
9.2.4.3	Fried fish and fish products, incl. MCE
9.3	Semi-preserved fish and fish products, incl. MCE
9.3.1	Fish and fish products, incl. MCE, marinated and/or in jelly
9.3.2	Fish and fish products, incl. MCE, pickled and/or in brine
9.3.3	Salmon substitutes, caviar and other fish roe products.
9.3.4	Semi-preserved fish and fish products, incl. MCE other than 9.3.1 - 9.3.3
9.4	Fully preserved fish and fish products, incl. MCE.
9.4.1	Canned
9.4.2	Cold Smoked
9.4.3	Hot Smoked
9.4.4	Fermented
9.4.5	Dried
10	**Eggs and egg products**

10.1	Fresh eggs
10.2	Egg products
10.2.1	Liquid egg products
10.2.2	Frozen egg products
10.2.3	Dried and/or heat coagulated egg products
10.3	Preserved eggs, incl. alkaline, salted, and canned eggs
10.4	Egg-based desserts (e.g. custard)

11	**Sweeteners, including honey**
11.1	White & semi-white sugar (sucrose or saccharose), fructose, glucose (dextrose), xylose; sugar solutions and syrups, also (partially) inverted sugars, incl. molasses, treacle, and sugar toppings.
11.2	Other sugars and syrups (e.g. , brown sugars, maple syrup)
11.3	Honey
11.4	Table-top sweeteners, incl. those containing high-intensity sweeteners, other than 11.1 - 11.3

12	**Salts, spices, soups, sauces, salads, protein products, etc.**
12.1	Salt
12.2	Herbs, spices, seasonings (incl. salt substitutes), and condiments
12.3	Vinegars
12.4	Mustards
12.5	Soups and broths
12.5.1	Ready-to-eat soups and broths
	Canned
	Bottled
	Frozen
12.5.2	Mixes for soups and broths
	Powdered cup soups
	Powdered packet soups
12.6	Sauces and like products
12.6.1	Emulsified sauces (e.g. mayonnaise, salad dressing)
12.6.2	Non-emulsified sauces (e.g. ketchup, cheese sauce, cream sauce, brown gravy)
12.6.3	Mixes for sauces and gravies
12.6.4	Soy sauce/soy sauce based products
12.6.4.1	Chicken marinade
12.6.4.2	Dark soy sauce
12.6.4.3	Dressing sauce (perilla)
12.6.4.4	Light soy sauce
12.6.4.5	Mushroom seasoning
12.6.4.6	Mushroom soy sauce
12.6.4.7	Oyster sauce
12.6.4.8	Raw fish soy sauce
12.6.4.9	Reduced salt soy sauce
12.6.4.10	Sauce for eel 'syzusho'
12.6.4.11	Seasoning sauce
12.6.4.12	Shrimp flavour soy sauce
12.6.4.13	Soy sauce
12.6.4.14	Sushi soya sauce
12.6.4.15	Teriyaki sauce
12.6.4.16	Thick soy sauce
12.6.4.17	Thin soy sauce
12.6.4.18	Vegetarian oyster sauce
12.7	Salads (e.g. macaroni salad, potato salad) and sandwich spreads (exc. cocoa- and nut-based spreads)
12.8	Yeast
12.9	Protein products

13	**Foodstuffs intended for particular nutritional uses**
13.1	Infant formulae and follow-on formulae
13.2	Foods for young children (weaning foods)
13.3	Dietetic foods intended for special medical purposes
13.4	Dietetic formulae for slimming purposes and weight reduction
13.5	Dietetic foods other than 13.1-13.4

13.6	Food supplements

14	**Beverages, excluding dairy products**
14.1	Non-alcoholic ("soft") beverages
14.1.1	Waters
	Natural mineral waters and source waters
	Table waters and soda waters
14.1.2	Fruit and vegetable juices
	Canned or bottles (pasteurised) fruit juice
	Canned or bottles (pasteurised) vegetable juice
	Concentrates (liquid or solid) for fruit juice
	Concentrates (liquid or solid) for vegetable juice
14.1.3	Fruit and vegetable nectars
	Canned or bottled (pasteurised) fruit nectar
	Canned or bottles (pasteurised) vegetable nectar
	Concentrates (liquid or solids) for fruit nectar
	Concentrates (liquid or solids) for vegetable nectar
14.1.4	Water-based flavoured drinks, incl. "sport" or "electrolyte" drinks
14.1.4.1	Carbonated drinks
14.1.4.2	Non-carbonated, incl. punches and ades
14.1.4.3	Concentrates (liquid or solid) for drinks
14.1.5	Coffee, coffee substitutes, tea, herbal infusions, and other hot cereal beverages, exc. cocoa.
14.1.5.1	Filter coffee
14.1.5.2	Tea (produced from a tea bag)
14.1.5.3	Herbal infusion (produced from a tea bag)
14.2	Alcoholic beverages, incl. alcohol-free and low-alcoholic counterparts
14.2.1	Beer and malt beverages
14.2.2	Cider and perry
14.2.3	Wines
14.2.3.1	Still wine
14.2.3.2	Sparkling and semi-sparkling wines
14.2.3.3	Fortified wine and liqueur wine
14.2.3.4	Aromatized wine
14.2.4	Fruit wine
14.2.5	Mead
14.2.6	Spirituous beverages
14.3	Other alcoholic beverages (e.g. beer, wine, or spirit coolers. etc.)

15	**Ready-to-eat savouries**
15.1	Snacks - potato, cereal, flour or starch based (from roots & tubes, pulses & legumes)
15.2	Processed nuts, incl. coated nuts and nut mixtures (with e.g., dried fruit)

16	**Composite foods (e.g. casseroles, meat pies)** - foods that could not be placed in categories 1-15.

Ingredient Categorisation System

Code	Description
17	**Breadcrumbs (coatings)**
17.1	Standard toasted
17.2	Japanese
17.3	Other
18	**Caramel**
18.1	Plain
18.2	Caustic sulphite
18.3	Ammonia
18.4	Sulphite ammonia
19	**Gelatine**
19.1	Acid-hydrolysis
19.2	Alkaline-hydrolysis
19.3	Enzyme-hydrolysis
20	**HVPs**
20.1	Enzyme-hydrolysis
20.2	Acid-hydrolysis
21	**Meat extract**
22	**Malts**
22.1	Brewing malt
22.2	Malt extract
22.3	Malt flour
22.4	Other
23	**Modified Starches**
23.1	Dextrins
23.2	Acid thinned
23.3	Other
24	**Yeast extract**
25	**Seasonings**
26	**Others**

Table 1A. Occurrence data for food samples (3-MCPD)															
Country:				**Units: mg/kg**											
Required information													Requested information if available		
Sample code (chloropropanol code/food code/ participant code/sample no)	Food Group	Description of food	Reference to published work	Date sample obtained	Date sample analysed	Composite/ individual sample	Replicate	Analytical method	lod (mg/kg)	loq (mg/kg)	Level of 3-MCPD (mg/kg)	Evidence of quality assurance	Country of origin	Ingredients	Processing details

Table 1B. Occurrence data for food ingredient samples (3-MCPD)																
Country:				**Units: mg/kg**												
Required information													Requested information if available			
Sample code (chloropropanol code/ingredient code/ country code/sample no)	Ingredient	Description of ingredient	Reference to published work	Date sample obtained	Date sample analysed	Composite/ individual sample	Replicate	Analytical method	lod (mg/kg)	loq (mg/kg)	level of 3-MCPD (mg/kg)	Evidence of quality assurance	Country of origin	Ingredients	Processing details	Known use of ingredient

ANNEX 3

List of Participants

Participating Country	Nominated Institute
Sweden (Joint co-ordinators)	Dr Marie Aune (acting joint co-ordinator) National Food Administration Strandbodgatan 4 SE-753 23 Uppsala Tel: + 46 18 175679 Fax: + 46 18 175848 E-mail: marie.aune@slv.se Dr Premysl Slania (joint co-ordinator) National Food Administration Tel: + 46 18 175696 E-mail: prsl@slv.se
United Kingdom (Joint co-ordinators)	Dr Karen Goonan (joint co-ordinator) Food Standards Agency Aviation House 125 Kingsway London WC2B 6NH Tel: + 44 207 276 8714 Fax: + 44 207 276 8717 E-mail: karen.goonan@foodstandards.gsi.gov.uk Miss PK Khaira Mrs Sue Johns Food Standards Agency
Austria	Dr Friedrich Sövegjarto Federal Institute for Food Control and Research (Bundesanstalt für Lebensmitteluntersuchung und -forschung) Kinderspitalgasse 15 A-1090 Vienna Tel: + 43 1 40490 27850 Fax: + 43 1 40490 9278 E-mail: friedrich.soevegjarto@luvie.ages.at
Denmark	Mr Arvid Fromberg Institute of Food Safety and Nutrition Danish Veterinary and Food Administration, Mørkhøj Bygade 19 DK-2860 Søborg Tel: + 45 33 95 6000 Fax: + 45 33 95 6001 E-mail: arf@fdir.dk

Finland	Mr Kalevi Siivinen Finnish Customs Laboratory Tekniikantie 13 FIN-02150 Espoo Tel: + 358 9 6143267 Fax: + 358 9 463383 E-mail: kalevi.siivinen@tulli.fi Dr Anja Hallikainen National Food Agency Vanha Talvitie 5, Box 28 FIN-00581 Tel: + 358 9 3931540 Fax: + 358 9 3931592 E-mail: anja.hallikainen@nfa.fi
France	Ms. Emmanuelle Rialland Centre National de la Recherche Scientifique (CNRS) Unité de prévention du risque chimique, UPS 831 Avenue de la Terrasse, Bâtiment 9 F-91198 GIF-sur-YVETTE Tel: + 33 1 69 82 39 95 Fax: + 33 1 69 82 39 92 E-mail: Emmanuelle.Rialland@icsn.cnrs-gif.fr
Germany	Dr R Tiebach Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV) Thielallee 88 – 92 D – 14105 Berlin Tel: + 49 0188 8412 3363 Fax: + 49 0188 8412 4741 E-mail: r.tiebach@bfr.bund.de
Ireland	Ms Sharon Crowe Public Analyst's Lab U.C.H.G. Seamus Quirke Road, Galway Tel: + 353 91 581122 Fax: + 353 91 581212 E-mail: Sharon.Crowe@whb.ie Previously Dr Margaret O' Sullivan Public Analyst's Lab, Galway
The Netherlands	Hans Jeuring Inspectorate for Health Protection and Veterinary Public Health The Hague Tel: + 31 70 340 5585 Fax: + 31 70 340 5435 E-mail: hans.jeuring@kvw.nl

	Paul I'nt Veld Inspectorate for Health Protection and Veterinary Public Health E-mail: paul.in.t.veld@kvw.nl
	Erik Konings Inspectorate for Health Protection and Veterinary Public Health E-mail: erik.konings@kvw.nl
	Jacqueline van der Wielen Inspectorate for Health Protection and Veterinary Public Health E-mail: jacqueline.van.der.wielen@kvw.nl
Norway	Mr Anders Tharaldsen Norwegian Food Control Authority P.O. Box 8187 Dep. N-0034 Oslo Tel: + 47 22 24 66 50 Fax: + 47 22 24 66 99 E-mail: ath@snt.no

Provision of advice on analytical methodology:

European Commission Joint Research Centre, Belgium	Elke Anklam Head of Food and Feed Unit Institute for Reference Materials and Measurements Retieseweg B-2440 Geel Tel: + 32 14 571 316 Fax: + 32 14 584 273 E-mail: elke.anklam@irmm.jrc.be

ANNEX 4

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