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Intake of ochratoxin A and deoxynivalenol through beer consumption in Belgium

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7 **Intake of ochratoxin A and deoxynivalenol through beer**
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10 **consumption in Belgium**
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48 **Running Head : Intake of Ochratoxin A and deoxynivalenol with beer**
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Abstract

The estimation of ochratoxin A (OTA) and 4-deoxynivalenol (DON) exposure of the Belgian population through beer consumption were made using the results of the recent Belgian food survey and the compiled data set of OTA and DON levels in conventionally and organically produced beers in 2003-2005. For the consumers of organic beers, the daily intake of OTA was 0.86 (in 2003), 1.76 (in 2004) and 0.72 (in 2005) ng kg⁻¹ bw, considering the mean beer consumption (0.638 l) and the average level of OTA in 2003, 2004 and 2005, respectively. Using the 97.5th percentile of beer consumption (1.972 l), the corresponding OTA daily intakes were 2.65, 5.44 and 2.24 ng kg⁻¹ bw, which are close or above the TDI of 5 ng kg⁻¹ bw. For the consumers of conventional beers, the OTA intakes were low: 0.23, 0.23 and 0.11 ng kg⁻¹ bw per day for the average beer consumption, in 2003, 2004 and 2005 against 0.72, 0.73 and 0.34 ng kg⁻¹ bw per day when the 97.5th percentile level was considered. As for the DON intake, the estimates were quite low for both conventional and organic beer consumers when the PMTDI of 1 µg kg⁻¹ bw was considered. Average consumption of organic beer led to daily intakes of 0.05 and 0.04 µg DON kg⁻¹ bw in 2003 and 2004, respectively, whilst for conventional beer, daily intakes were 0.07 and 0.05 µg DON kg⁻¹ bw. At the 97.5th percentile level of beer consumption, daily intakes of 0.15 and 0.13 µg kg⁻¹ bw were obtained for organic beers against 0.23 and 0.17 µg kg⁻¹ bw for conventional ones. The results showed that beer could be an important contributor to OTA exposure in Belgium even though a declining trend seems to be apparent during the last year of monitoring. Therefore efforts should be devoted to maintain the OTA levels as low as reasonably achievable, especially for organic beer.

Key words: Intake, mycotoxins, ochratoxin A, deoxynivalenol, beer, organic, Belgium

Introduction

Cereals (*Triticum aestivum* and *Hordeum vulgare*) and derived products (flour, bread, pastry, beer) are important commodities susceptible to be contaminated by mycotoxins. Their contamination by *Fusarium* mycotoxins such as nivalenol, deoxynivalenol (DON), 3-acetyl-DON, 15-acetyl-DON starts in the field as a consequence of *F. graminearum* and *F. culmorum* attacks during flowering. Wet weather years are known to aggravate contamination by DON, one of the most important trichothecenes of group B. Ochratoxin A (OTA) is another toxin produced by some *Penicillium* and *Aspergillus* species mainly during the storage of cereals. High moisture contents and lack of hygienic measures (presence of dust and moulded grains in the storage facilities) are known to be factors favouring contamination by OTA and other mycotoxins (Tangni and Pussemier 2006). The International Agency for Research on Cancer (IARC 1993) has classified OTA in category 2B (possibly carcinogenic to humans) on the basis of clearly carcinogenic effects in animals. OTA contamination will be more intense when the grains are not sufficiently dry.

Due to food crises in the past (e.g. bovine spongiform encephalopathy (BSE), Belgian dioxin incident in 1999), organic food products have become more popular in Belgium and elsewhere (Pussemier *et al.* 2006). Organic is a labelling term for products that have been obtained in accordance with organic standards throughout production, handling, processing and marketing stages and certified by a duly constituted certification body or authority. For the general public, however, organic agriculture is often understood in a restricted sense, *i.e.* a farming system where synthetic pesticides and fertilizers are not authorized. The use of pesticides to reduce microbial contamination during cereal production and storage, as well as the addition of preservatives at different stages of foodstuff production and distribution, may lead to the presence of residues in the final products, which represent a possible threat for the

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2
3 safety of conventional products. In contrast, the non-use of pesticides or preservatives may
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5 result in increasing fungal contamination and, eventually, in increasing the amount of
6
7 mycotoxins in the final products. So, there is evidence that organic food often contains
8
9 relatively high amounts of natural toxic compounds produced by fungi or plants, whereas
10
11 corresponding conventional food tends to contain more synthetic compounds such as
12
13 pesticide residues (Finamore *et al.* 2004, Pussemier *et al.* 2006). Moreover, the use of
14
15 pesticides or preservatives in insufficient amounts could lead to an even worse situation since
16
17 the stress imposed on the moulds is thought to stimulate mycotoxin production. In principle,
18
19 although the foodstuffs resulting from conventional production are not free of mycotoxins, the
20
21 organic foodstuffs may present in some circumstances a greater risk of contamination.
22
23 Moreover, as there is a greater number of microorganism species able to develop during the
24
25 organic production (in contrast to the conventional counterpart), a wider spectrum of
26
27 mycotoxins may potentially be detected in the organic foodstuffs than in the conventional
28
29 counterparts. So, there is a need for information related to food safety, to inform consumers of
30
31 the health benefits and/or hazards of food products of both origins, in order to optimize the
32
33 impact on health and minimize the risks. Identification and quantitative assessment of
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35 mycotoxins present in specific raw materials, feed and foodstuffs, as well as in manufactured
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37 food, thus deserve further safety evaluation for public health concerns.
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47 Exposure to mycotoxins in food is a widely recognized health risk that is receiving increasing
48
49 attention (Bhat and Vasanthi 1999). Indeed, mycotoxins are associated with various acute and
50
51 chronic diseases in domestic animals, livestock and humans in many parts of the world. They
52
53 have various toxicological effects such as immunotoxicity, teratogenicity, mutagenicity
54
55 and/or carcinogenicity in certain susceptible animal species and/or in humans. In recent years,
56
57 thorough risk assessments of the DON and of OTA established a provisional maximum
58
59 tolerable daily intake (PMTDI) of 1 µg DON kg⁻¹ bw and a tolerable daily intake (TDI) of 5
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3 ng OTA kg⁻¹ bw (FAO/WHO 2001). Note that the European Food Safety Authority (EFSA)
4
5 has recently proposed a new safety value of 120 ng OTA kg⁻¹ bw as a tolerable weekly intake,
6
7 which corresponds to a TDI of 17.1 ng kg⁻¹ bw (EFSA, 2006). This value is three times higher
8
9 than the current TDI (FAO/WHO 2001).
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12
13 DON and OTA are worldwide provided through beer consumption and it is suggested to
14
15 include beer consumption in calculations of total exposure to DON and OTA, together with
16
17 other sources of cereals and other foodstuffs, which undoubtedly provide these mycotoxins as
18
19 well (Visconti *et al.* 2000, Tangni *et al.* 2002, Papadopoulou-Bouraoui *et al.* 2004, Anselme
20
21 *et al.* 2006). Indeed, malting barley, wheat and corn which are used in brewing can be
22
23 contaminated with OTA and/or DON. The maximum acceptable levels in malt are fixed at
24
25 750 µg DON kg⁻¹ and 3 µg OTA kg⁻¹ for malt and other processed cereals (EU 2001a and EU
26
27 2001b). These mycotoxins partially withstand the brewing, and finally remain present in beer
28
29 (Niessen and Donhauser 1993; Baxter 1996; Baxter *et al.* 2001; Papadopoulou-Bouraoui *et al.*
30
31 2004). So far, there is no proposed legal limit for DON in beer whilst maximum acceptable
32
33 level was proposed at 200 ng OTA L⁻¹ beer (FAO 2004).
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41 In Belgium, Tangni *et al.* (2002) and Anselme *et al.* (2006) have conducted surveys on beers
42
43 sold on the Belgian market and performed point-estimations of OTA and DON intakes using a
44
45 daily consumption of 0.3 L beer per capita (CBB 2004). Note that the determination of this
46
47 consumption was mainly based on the volume of manufactured, exported and imported beers
48
49 in the Belgian markets.
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52
53 Food consumption data from a recent national food survey carried out in Belgium by the
54
55 Institute of Public Health (Brussels) are now available. We therefore gathered data on OTA
56
57 and DON in beers from surveys carried out in Belgium during 2003-2005 and, using the
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1
2
3 recent dietary survey, we performed an assessment of the OTA and DON exposure of the
4
5 Belgian population through the consumption of conventional or organic beer.
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8 9 **Data input and statistical analysis**

10 11 *Database on food consumption in Belgium*

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16 Data from a 2004-food survey carried out in Belgium by the Institute of Public Health
17
18 (Brussels), have been used to estimate intakes for the average population (beer consumers and
19
20 no consumers all together) (IPH 2006) as well as for the beer consumers only (Temme,
21
22 personal communication). The 24 hours-recall method using EPIC-SOFT was used to perform
23
24 the dietary survey over four different seasons from February 2004 to March 2005. For the
25
26 beer consumer population, 765 subjects were interviewed with 1,064 days of consumption
27
28 while for the entire population, the survey was made with 3,083 subjects older than 15 years
29
30 old with 6,166 days of consumption.
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34 35 *Databases of OTA and DON occurrence in beer*

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39 A large number of samples were included to ensure enough data for the risk assessment. DON
40
41 and OTA databases from a survey performed by Anselme *et al.* (2006) and by the Federal
42
43 Agency for the Safety of the Food Chain (FASFC). Thus, data collected from 2003 to 2004 on
44
45 42 conventionally produced beers and 33 organically produced beers purchased in
46
47 supermarkets and retail shops were employed (Anselme *et al.* 2006). In addition, mycotoxin
48
49 analysis results of 18 conventionally produced beers sampled in 2005 (9 for OTA and 9 for
50
51 DON) were also provided by FASFC. Finally, OTA contents in 18 additional samples (10
52
53 conventional and 8 organic) in 2005 were also used (Anselme *et al.* 2006).
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59 The mycotoxin contents are expressed in ng per L of beer for OTA and µg per L of beer for
60
DON. The data of the results of mycotoxin analyses were treated as follows: for non-detects

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3 samples (value under the limit of detection, LOD), values were assumed to be 0.5 x LOD
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5 while for trace levels (between the LOD and the limit of quantification, LOQ), values were
6
7 assumed to be 0.5 x (LOD + LOQ) (Kroes *et al.*, 2002). Data are reported as mean ± standard
8
9 deviation (SD) and as percentiles.
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12 13 *Data handling and risk assessment* 14

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17 Intakes are estimated by multiplying beer consumption data either for the whole population or
18
19 for the beer consumers by the average concentrations of mycotoxins present in the product.
20
21 The use of average mycotoxin concentration in the intake calculations provides a realistic and
22
23 appropriate estimation of the long-term exposure, since these intakes are compared with
24
25 reference toxicological intake (TDI) (FAO/WHO 1997). Because of the numerous ‘not
26
27 quantified’ and ‘not detected’ values and the mathematical assumptions made concerning
28
29 these data, the values obtained with respect to risk quantification should be interpreted with
30
31 caution.
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37 The purpose of the risk assessment is to compare the intake determined for average, median,
38
39 97.5th and even 99th percentile levels of food consumption with the reference toxicological
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41 values established by the national, European or international scientific committees. The
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43 results obtained are thus expressed either as daily intakes in terms of ng OTA kg⁻¹ bw day⁻¹,
44
45 µg DON kg⁻¹ bw day⁻¹ or as percentage of the TDI. Taking into account the different body
46
47 weight values proposed in neighboring countries (SCOOP, 2002), the intake calculation was
48
49 performed for an adult of 66 kg body weight.
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53 54 **Results and discussion** 55

56 57 *Beer consumption in Belgium* 58 59 60

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3 Beer consumption data for the total population as well as for the beer consumers are shown in
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5 Table I. This database integrates different levels of beer consumption such as average but also
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7 25th, 50th, 75th and 97.5th percentiles.
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11 [Insert table I about here]
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15 No significant regional variation between Flanders in one hand and Brussels and Wallonia in
16
17 other hand was observed. Beer consumption is prone to be higher for men than for women
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19 (215.3 mL versus 36.8 mL). Spring and summer periods are more favorable for beer drinking
20
21 while the high consumer's ages ranged from 19 to 74 years.
22
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24 25 *Occurrence of OTA and DON in beer* 26

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28 Results of OTA and DON occurrence from the database gathered in Belgium are summarized
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30 in Tables II and III, respectively.
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34 [Insert table II about here]
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38 [Insert table III about here]
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41
42 OTA presence in organically produced beer is significantly higher ($p < 0.0001$) than in
43
44 conventionally produced beers over 2003-2005 even if a decreasing trend could be observed
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46 in 2005. Indeed, in 2005, the OTA levels were all below the limit of 200 ng OTA L⁻¹. As for
47
48 the occurrence of DON, there is no significant difference between conventional and organic
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50 beers. It must pointed out that a total of 102 samples (61 conventional and 41 organic) were
51
52 analyzed, which is rather low knowing that the total beer production in Belgium was 16
53
54 million hl in 2003 (CBB 2004).
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57 58 *Intakes of OTA and DON through beer consumption* 59 60

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3 Consumer exposure assessments to mycotoxins have traditionally relied on deterministic
4 calculations. Using this approach, the results of the OTA and DON daily intakes estimated
5 expressed in ng OTA kg⁻¹ bw and in µg DON kg⁻¹ bw are summarized in Tables IV and V,
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10 respectively.

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13 [Insert table IV about here]

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17 [Insert table V about here]

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20 For the consumers of conventional beer, the intake of OTA remains below 1 ng kg⁻¹ bw,
21 whatever the level of beer consumption throughout 2003-2005 (Table IV). In contrast, for the
22 consumers of organic beer, the OTA intake in 2003 was 66 % of the TDI level at the 99th
23 percentile of beer consumption (3.3 ng kg⁻¹ bw), while in 2004, it exceeded the TDI at the
24 97.5th percentile of beer consumption (5.44 ng kg⁻¹ bw) (Table IV). In 2005, the intake at the
25 99th percentile was 55.8 % of the TDI (2.79 ng kg⁻¹ bw).
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35 As for the exposure to DON, the results presented in Table V show that the intakes remain
36 low in all conditions throughout 2003-2005. Even for high beer consumers (99th percentile),
37 the intake reached a maximum of 0.29 and 0.21 µg kg⁻¹ bw day⁻¹ in 2003 and 2004,
38 respectively. In 2005, the intake was 0.32 µg kg⁻¹ bw day⁻¹.
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46 *Risk assessment*

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49 In recent years, thorough risk assessments of OTA and DON established a TDI of 5 ng OTA
50 kg⁻¹ bw and a provisional maximum TDI (PMTDI) of 1 µg DON kg⁻¹ bw (FAO/WHO 2001).
51
52
53 These values are used in the present study.
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57
58 *Average beer consumption and OTA and DON exposure.* Considering a mean daily intake of
59 0.638 L beer *per capita* in Belgium (consumers population) and the mean level of OTA
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3 found, beer consumption contributes to $1.11 \text{ ng OTA kg}^{-1} \text{ bw}$, which is equivalent to 22.2 %
4
5 of TDI (for organically produced beer) or to $0.19 \text{ ng OTA kg bw}^{-1}$, which is equivalent to 3.8
6
7 % of TDI (for conventionally produced beer). Regarding DON, beer contributes to $0.045 \text{ } \mu\text{g}$
8
9 $\text{DON kg}^{-1} \text{ bw}$, equivalent to 4.5 % of PMTDI (for organically produced beer) or to $0.067 \text{ } \mu\text{g}$
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11 $\text{DON kg}^{-1} \text{ bw}$, equivalent to 6.7 % of PMTDI (for conventionally produced beer) for an adult
12
13 of 66 kg. Considering a mean daily intake of 0.122 L beer *per capita* for the entire population,
14
15 beer consumers' intake is estimated at 4.2 % or 0.7 % of the OTA-TDI, considering organic
16
17 or conventional beer consumption, respectively. As regard to DON, the corresponding intakes
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19 are 0.9 % (for organic beer) and 1.3 % (for conventional beer) of the PMTDI. Note that the
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21 beer consumption for Belgium proposed by the Belgian Brewers Confederation (CBB 2004)
22
23 is 0.3 L *per capita*, which is higher than the mean consumption data provided by the recent
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25 official food survey. Accordingly, one could argue whether an average underestimation for
26
27 the entire population may be presently performed.
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35 *Risk assessment for DON.* The results of DON intakes determined in this study show that
36
37 Belgian beer consumption habits do not bear a risk of high DON intake whatever the beer
38
39 consumption level, the year of monitoring and the organic route of production (organic vs.
40
41 conventional). Indeed, considering all years and mode of production together, the highest
42
43 exposure for the beer consumer population is $0.26 \text{ } \mu\text{g DON kg}^{-1} \text{ bw}$ (equivalent to 26 % of
44
45 PMTDI) at the 97.5th percentile of consumption and $0.32 \text{ } \mu\text{g DON kg}^{-1} \text{ bw}$ (equivalent to 32
46
47 % of PMTDI) at the 99th percentile of consumption (Table V). Anselme *et al.* (2006) already
48
49 concluded from the analysis of a more limited data set that DON contamination in Belgian
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51 beers should not be a major matter of concern, but care should taken to maintain this low
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53 level.
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3 *Risk assessment for OTA.* The OTA exposure through beer consumption can be high,
4 especially when organically produced beers are chosen. The 97.5th percentile exposure is 5.44
5 ng OTA kg⁻¹ bw (equivalent TDI of 108.8%) for the beer consumer population and 2.14 ng
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Risk assessment for OTA. The OTA exposure through beer consumption can be high, especially when organically produced beers are chosen. The 97.5th percentile exposure is 5.44 ng OTA kg⁻¹ bw (equivalent TDI of 108.8%) for the beer consumer population and 2.14 ng OTA kg⁻¹ bw (equivalent TDI of 42.8 %) for the entire population, by the consumption of organically produced beer. Within the Belgian population, the most endangered group is the male of age 19-59 years, where the intake of OTA at 97.5th percentile exposure is 2.20 ng OTA kg⁻¹ bw (44 % of TDI) in 2004, with organic beer consumption.

Tangni *et al.* (2002) and Anselme *et al.* (2006) have conducted surveys on beers found on the Belgian market. From these studies, it appears that the level of OTA contamination is very variable either in the organic or in the conventional brands but in both studies, the contamination tends to be higher for organic beers. The situation improved from 2003-2004 to 2005 since maximum levels have been newly imposed on malt (EC No 466/2001 and EC No 856/2005) but the number of analyzed samples is quite low for 2005 and additional efforts should be devoted to continue the monitoring of organic and conventional beers.

Table VI allows a comparison of OTA intakes linked to average beer consumption in several European countries.

[Insert table VI about here]

Note that only conventional beer is considered because of its worldwide production and consumption whilst organic beer is quite marginal and data on organic beer contamination are scarce. As can be seen from the data, average OTA intake with beer is quite higher in Belgium due to higher average consumption habits (FPS-Economy 2003, SCOOP 2002). However, this average intake still remains below 5 % of TDI. Taking into account the beer consumers at higher percentiles, intakes will reach, for some part of the population, much higher values, exceeding in some cases the TDI that has been set considering all foodstuffs

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3 together. There is thus a need to lower as much as possible the OTA levels in beer taking into
4
5 account the consumption habits in Belgium.
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9 The limit of 200 ng OTA L⁻¹ in beer has been proposed (EC 1998, FAO 2004). Applying this
10
11 proposed level to the Belgian food consumption data, the result shows that the mean exposure
12
13 for the total population would be 0.37 ng OTA kg⁻¹ bw (7.4 % of TDI), whereas the 97.5th
14
15 percentile exposure of the total population reaches 2.36 ng OTA kg⁻¹ bw (47.2 % of TDI).
16
17 Considering the consumers only, mean consumption contributes to an exposure of 1.93 ng
18
19 OTA kg⁻¹ bw (38.6 % of TDI) and with high consumption (97.5th percentile) it will reach 5.97
20
21 ng OTA kg⁻¹ bw, which clearly exceeds the TDI (119.5 %). Thus, taking into account the
22
23 Belgian beer consumption habits, 200 ng OTA l⁻¹ concentration can bear risk for the
24
25 consumers. Note that beer is not the only foodstuff contributing to the OTA exposure. Cereals
26
27 and cereal products, coffee, wine, cocoa-derived products, dried fruits, spices can also contain
28
29 significant amounts of OTA (SCOOP 2002).
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36 In the light of the above results, beer derived from locally produced or imported cereals, can
37
38 be contaminated by DON, a field produced mycotoxin as well as OTA, a typical storage
39
40 mycotoxin, which can be produced by moulds in high amounts under conditions prevailing in
41
42 Belgium and elsewhere (Tangni and Pussemier 2006). So far, occurrence of DON in beer has
43
44 not to be considered as a major cause for concern since the contamination levels are very low.
45
46 In contrast, there is a risk of exposure to a significant amount of OTA with respect to the
47
48 tolerable daily intake. The risk seems to be significantly higher for consumers of organic beer.
49
50 Limited data available so far seem to indicate a recent reduction of OTA contamination,
51
52 probably as a consequence of the implementation of EU regulation No 466/2001 and EC No
53
54 856/2005 that limit OTA in malt to a maximum content of 3 µg kg⁻¹. Nevertheless, since it
55
56 appears that a limit of 200 ng OTA L⁻¹ would not allow a satisfactory level of protection for
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2
3 the high consumers, the question is raised whether more stringent regulations should apply to
4
5 beer in Belgium as well as in other countries with high beer consumption habits such as
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7 Czech Republic, United Kingdom, Germany, Ireland, Austria and Denmark.
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11 Obviously, there is thus a need to increase the monitoring of beers taking into account the
12
13 numerous factors able to influence the contamination and the large variability due to the high
14
15 number of brands and brewing processes existing in some specific countries like Belgium
16
17 (CBB 2004). In addition, a probabilistic assessment of the OTA intake by the Belgian
18
19 population should be carried out, taking into account the regional, seasonal, gender and age
20
21 specific habits of beer consumption as well as all the other dietary sources of OTA intake.
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Table I: Weighed mean and percentiles of beer consumption (ml/day) for consumers only and for the total population (consumers and non consumers) according to the region, sex, season and age of consumers in Belgium.

	Mean	SD	P25	P50	P75	P97.5
For consumers, during consumption days	637.9	499.1	312	482	787	1972
Total population, all days	122.1	228.6	0	0	162	778
- Regional distribution						
Flanders	127.5	208.8	0	8	171	725
Brussels & Walonia	110.9	185.8	0	0	163	626
- Gender distribution						
Female	36.8	79.1	0	0	39	261
Male	215.3	294.2	0	111	310	1042
- Seasonal distribution						
Spring	149.1	225.6	0	0	193	761
Summer	140.8	217.6	0	39	207	738
Autumn	107.9	179.3	0	0	155	626
Winter	77.2	134.4	0	0	104	459
- Age distribution						
< 18 years	68.7	113.8	0	0	109	387
19- 59 years	138.0	232.3	0	15	197	797
60 -74 years	107.9	197.1	0	0	151	672
>75 years	60.8	118.8	0	0	78	401

Sources: For the entire population: (<http://www.iph.fgov.be/epidemiol/>) and for consumers only: (Temme, personal communication)

Table II: Occurrence of OTA in organic and conventional beers sold on the Belgian beer market (ng l⁻¹)

	2003			2004			2005		
	Conventional	Organic	Total	Conventional	Organic	Total	Conventional	Organic	Total
n	22	13	35	20	20	40	19	8	27
Mean	24	89	48	25	182	103	11	75	30
sd	31	137	92	38	275	162	18	56	44
Median	16	22	19	15	45	29	2.7	54	12
P95	54	420	197	52	592	533	54	155	135
Maximum	149	500	500	174	1111	1111	67	158	158

n, number of samples; sd, standard deviation

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Table III: Occurrence of DON in organic and conventional beers sold on the Belgian beer market ($\mu\text{g l}^{-1}$)

	2003			2004			2005		
	Conventional	Organic	Total	Conventional	Organic	Total	Conventional	Organic	Total
n	22	13	35	20	20	40	9	0	9
Mean	7.8	5.0	6.8	5.8	4.4	5.1	8.7	-	8.7
sd	6.5	0	5.3	5.6	2.7	4.5	9.5	-	9.5
Median	5.0	5.0	5.0	4.0	4.0	4.0	4.0	-	4.0
P95	23	5.0	23	15	7.6	14	15	-	15
Maximum	23	5.0	23	22	13	22	29	-	29

n, number of samples; sd, standard deviation

Table IV: OTA daily intake* through beer consumption in Belgium for the entire population and for the beer consumers specifically (ng OTA kg⁻¹ bw day⁻¹)

	2003		2004		2005	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	0.23 (0.04)	0.86 (0.16)	0.23 (0.04)	1.76 (0.33)	0.11 (0.02)	0.72 (0.14)
P25	0.11 (0)	0.42 (0)	0.11 (0)	0.86 (0)	0.05 (0)	0.35 (0)
P50	0.17 (0)	0.65 (0)	0.18 (0)	1.33 (0)	0.08 (0)	0.55 (0)
P75	0.28 (0.06)	1.06 (0.22)	0.29 (0.06)	2.17(0.44)	0.13 (0.03)	0.89 (0.19)
P97.5	0.72 (0.28)	2.65 (1.04)	0.73 (0.28)	5.44 (2.14)	0.34 (0.12)	2.24 (0.79)
P99	0.90 (0.40)	3.30 (1.48)	0.9 (0.4)	6.75 (3.03)	0.41 (0.18)	2.78 (1.25)

*: The first figure is for "Consumers only" whereas the figure in bracket is for "all population".

Table V: DON daily intake* through beer consumption in Belgium for the entire population and for the beer consumers specifically ($\mu\text{g DON kg}^{-1} \text{ bw day}^{-1}$)

	2003		2004		2005	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	0.07 (0.01)	0.05 (0.01)	0.05 (0.01)	0.04 (0.01)	0.08 (0.02)	nd**
P25	0.03 (0)	0.02 (0)	0.02 (0)	0.02 (0)	0.04 (0)	nd
P50	0.06 (0)	0.03 (0)	0.04 (0)	0.03 (0)	0.06 (0)	nd
P75	0.09 (0.02)	0.06 (0.01)	0.07 (0.01)	0.05 (0.01)	0.10 (0.02)	nd
P97.5	0.23 (0.09)	0.15 (0.06)	0.17 (0.07)	0.13 (0.05)	0.26 (0.10)	nd
P99	0.29 (0.13)	0.18 (0.08)	0.21 (0.09)	0.16 (0.07)	0.32 (0.15)	nd

*: The first figure is for "Consumers only" whereas the figure in bracket is for "all population".

** nd, no data

Table VI: OTA intake with average beer (only conventional) consumption in few European Countries compared to the Belgian data.

Countries	Average* beer consumption	OTA average* intake with beer		References
	ml day ⁻¹	ng kg ⁻¹ bw day ⁻¹	% of TDI	
Denmark	203.8 (-)	0.14 (-)	2.8 (-)	SCOOP 2002
Finland	230 (-)	0.12 (-)	2.4 (-)	
Italy	110.83 (23.03)	0.03 (0.01)	0.6 (0.2)	
Portugal	- (177.3)	- (0.01)	- (0.2)	
Belgium	637.9 (122.1)	0.19 (0.03)	3.8 (0.7)	Present study, 2006

*: The first figure is for “Consumers only” whereas the figure in bracket is for “all population”.

(-): data missing