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Ethanol Concentration in Breastmilk After the Consumption of Non-alcoholic Beer

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Abstract

Background: During lactation, the consumption of ethanol is discussed controversially. After women drink alcoholic beverages, ethanol can be found in breastmilk with a time lag. To abstain from ethanol, but not from the taste of alcoholic beverages, in particular, non-alcoholic beer has become popular in recent years. According to regulations in the United States and most European countries, these "alcohol-free" beverages may still contain ethanol up to 1.2% by volume. To determine how much of this ethanol may reach the breastfed child, a drinking experiment with non-alcoholic beer was performed.
Subjects and Methods: Fifteen healthy breastfeeding women participated in the study. After at least 5 days of abstinence from ethanol and the donation of a void breastmilk sample, they were asked to drink 1.5 L of non-alcoholic beer within 1 hour. Breastmilk samples were collected using electronic breast pumps immediately after the end of drinking as well as 1 and 3 hours later. The milk was analyzed for ethanol by headspace–gas chromatography–flame ionization detection using a fully validated method.
Results: In two women, trace amounts of ethanol (up to 0.0021 g/L) were found in the samples gained immediately after the drinking period. In the other samples ethanol could not be detected (limit of detection = 0.0006 g/L).
Conclusions: The mother's consumption of non-alcoholic beer is likely innocuous for the breastfed infant.

Introduction

During pregnancy, health professionals commonly advise strict abstinence from alcohol. Severe health impairment of the children, first and foremost with the fetal alcohol syndrome, is ascribed to immoderate ethanol consumption.[1–3]

During lactation, the consumption of ethanol is controversial. There is still a general opinion and folklore that alcoholic beverages like beer lead to an increase of breastmilk production.[4–6] In contrast to that, scientific preclinical and clinical investigations report on a significant decrease of the breastmilk amount in humans as well as in mammals after the consumption of ethanol.[7,8] Furthermore, the volume of sucked milk is negatively influenced by ethanol containing breastmilk.[5,9,10] Weaning is recommended in cases of chronic and/or excessive ethanol consumption of the breastfeeding mother.

When ethanol is drunk by a breastfeeding woman, it can be found in the breastmilk with a time delay of 30–60 minutes and reaches the breastfed infant.[10] The infant, with immature organs, is far more sensitive to ethanol than are adults. The activity of alcohol dehydrogenase, the main enzyme for metabolizing ethanol in adults, is much lower.[11] It is still discussed whether other enzymes, like catalase, may compensate—at least in part—for the alcohol dehydrogenase deficit.[12] The repeated exposure to ethanol-containing breastmilk is associated with sleep disorders and detrimental effects on motor development.[10,13]

Against this background, many breastfeeding women abstain from ethanol and turn toward so-called non-alcoholic beverages. In particular, non-alcoholic beer has become popular in this context. According to regulations, these "alcohol-free" beverages may still contain residual ethanol. In the United States the residual content of ethanol was first treated in the (nowadays inoperative) Volstead Act and set at 0.5% by volume. Also, in most European countries the limit is defined as 0.5% by volume ethanol, whereas, for example, in France and Italy beverages with up to 1.2% by volume are classified as non-alcoholic [EU health claim (EG) 1924/2006, December 20, 2006].

In a former drinking experiment (with nonlactating participants) in our institute, after the consumption of 1.5 L of non-alcoholic beer within 1 hour, maximum blood ethanol concentrations of 0.006 g/kg were found.[14] To determine how much of this ethanol from "non-alcoholic" beverages may reach the breastfed child, a drinking experiment with

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"alcohol-free" beer was performed, and the breastmilk was analyzed for ethanol.

Subjects and Methods

Experimental setup

The study was approved (protocol number 279/09) by the ethics committee of Freiburg University, Freiburg, Germany. Written informed consent was obtained from each participant.

The drinking experiment was performed as follows. After at least 5 days of abstinence from alcoholic beverages and the collection of a void breastmilk sample, 15 healthy breastfeeding women (age range, 18–46 years; mean age, 32.4 years; median age, 32 years; body weight range, 44.5–78.5 kg; mean body weight, 66.3 kg; median body weight, 70 kg; body height range, 152–180 cm; mean and median body height, 167 cm; body mass index range, 18.4–28.5 kg/m^2; mean body mass index, 23.6 kg/m^2; median body mass index, 23.4 kg/m^2; infant's age range, 2–21 weeks; infant's mean and median age, 12 weeks; 14 fully breastfed and one infant taking nourishment other than by suckling) were asked to drink 1.5 L of non-alcoholic beer within 1 hour at least 2 hours after a light breakfast. This amount (three bottles each of 0.5 L) was chosen as very high deliberate drinking volume. The liquid volume and also the carbon dioxide seem to limit a possible maximum uptake. According to the brewery, the ethanol content of the non-alcoholic beer is 0.41–0.43% by volume, which was verified by headspace–gas chromatography–flame ionization detection analysis. For 4 hours after the beginning of the beer consumption breastmilk samples were collected using a breast pump (Elite; Ameda, Lincolnshire, IL). The pumps were stopped when the milk flow ended. In all cases, a sufficient amount of breastmilk could be gained for each sampling time; the minimum sample amount was 40 mL. Contamination of the samples with beer was prevented by spatial separation. Aliquots of 5 mL were stored in a closed container at −18°C prior to ethanol determination. The scheme of sampling is shown in Table 1.

Additional information was gained by a questionnaire. The questionnaire included questions for the mother's and the infant's age, mother's body height and weight, the general drinking behavior, and the consumption of ethanol within the last few weeks before the drinking experiment. Furthermore, the period of time between the last breastfeeding and the beginning of the consumption of non-alcoholic beer were obtained.

Table 1. Scheme of Sampling

	Time of sampling	
	Right breast	*Left breast*
Void sample	—	Before starting to drink
Sample 1	At the end of the drinking period	
Sample 2	1 hour after the end of drinking	
Sample 3	3 hours after the end of drinking	

Chemicals and instrumentation

The ethanol concentrations in breastmilk and beer were measured using two headspace–gas chromatography–flame ionization detector instruments operated with different types of separation columns showing varying selectivity. Analyses were performed according to German forensic regulations with multiple determinations (duplicate measurement with each instrument and calculation of the mean value). An internal standard of 500 μL of *t*-butanol (0.005 g/L) were added to 100 μL of breastmilk in an air-tight 20-mL headspace container. Ethanol determination was performed using daily linear calibration (calibration range, 0.001–0.050 g/L) with aqueous ethanol solutions. The limit of detection was 0.0006 g/L; the lower limit of quantitation was the lowest calibrator's concentration (0.001 g/L).

Results

The mother's weight ranged from 45 to 78.5 kg, and the heights were between 152 and 180 cm. The age of the children varied from 2 to 21 weeks (Table 2).

The ethanol concentration of the "non-alcoholic" beer was 0.42% by volume. Two of the 105 breastmilk samples contained

Table 2. Overview of Results

Test person	*Mother's body weight [kg]*	*Mother's body height (cm)*	*Child's age (weeks)*	*Sample number*	*Ethanol concentration*	*Time since last breastfeeding (minutes)*	*Duration of drinking period (minutes)*
P1	68	165	3	—	—	135	73
P2	65	172	17	—	—	130	80
P3	63	168	17.5	—	—	175	85
P4	75	167	15	—	—	140	80
P5	78.5	166	2.5	—	—	150	80
P6	45	152	11	—	—	150	90
P7	57	160	10	Sample 1	< 0.001 g/L	60	90
P8	70	173	21	Sample 1	0.0021 g/L	90	45
P9	60	165	15	—	—	170	60
P10	74	163	2	—	—	135	60
P11	73	170	21	—	—	125	70
P12	73	170	12	—	—	105	60
P13	76	180	9	—	—	165	60
P14	70	175	16	—	—	135	95
P15	47	160	6	—	—	50	70

A dash indicates not detectable.

detectable amounts of ethanol, with one of them above the lower limit of quantitation. In test person 7 a trace amount of ethanol above the limit of detection was found in sample 1 from the left breast; in test person 8 sample 1 from the left breast showed an ethanol concentration of 0.0021 g/L (Table 2).

The period of time between the last breastfeeding and the beginning of the consumption of non-alcoholic beer varied from 50 to 175 minutes. Furthermore, the women were asked to drink the whole volume of 1.5 L of non-alcoholic beer within 1 hour, but not all of them managed to do so; in seven cases it took up to 1.5 hours to drink the provided beverage amount (Table 2).

Discussion

The two ethanol-positive samples were taken immediately after drinking from the left breast, from which also the void sample was taken before the drinking period. The maximum concentration measured was 0.0021 g/L. The positive samples were obtained from women with a short period of time between the last breastfeeding and the start of the experiment: in test person 7, 60 minutes had passed, whereas in test person 8 the time was 90 minutes. It is assumed that the rate of milk formation is increased after breastfeeding and therewith during the time of ethanol consumption and resorption. In combination with less dilution by preexisting milk, this could explain the positive findings.

The only quantifiable alcohol concentration in breastmilk was found in the woman with the shortest drinking period of only 45 minutes. This woman was the only test person who managed to drink the volume of 1.5 L within less than 1 hour. The comparably fast absorption of ethanol along with this and an assumably higher peak blood ethanol concentration may account for this finding.

Test person 15 also had the shortest time interval between the last breastfeeding and the start of the experiment. In particular, in contrast to participant 8, the child was distinctly younger (6 weeks compared with 21 weeks) and may therefore not have the same ability to suck milk from the breast. The remaining breastmilk can serve as explanation for the different findings in the test persons with similar time parameters.

This study is restricted by the fact that the findings can only be applied to the common limit of residual ethanol contents of up to 0.5% by volume. With regard to the highest measured concentration of 0.0021 g/L, an infant consuming an average breastfeeding drinking amount of 100 mL of breastmilk would ingest 0.21 mg of ethanol. Therefore, the mother's consumption of non-alcoholic beer can be regarded as innocuous for the breastfed infant.

Conclusions

In summary, it can be stated that even after the consumption of large amounts of non-alcoholic beer (0.41–0.42% by volume), only trace amounts of ethanol reach the breastmilk. These findings suggest that consumption of non-alcoholic beer is very likely innocuous for the breastfed infant.

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Disclosure Statement

No competing financial interests exist.

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