The Effects of Low Alcohol Beers on the Blood Alcohol Concentration

Introduction

During the last decade the consumption of low alcohol beers has increased considerably in the Netherlands. The improved taste and appearance of these beers, compared to those of previous years, combined with a more general trend for a healthier life-style might explain this increase. The permanent public information and education on the risks of drunken driving may have also contributed.

The drinking of low alcohol beers instead of the traditional beers has a traffic safety aspect. On theoretical grounds it can be predicted that the consumption of even large quantities of low alcohol beer leads to very low blood alcohol concentrations (BAC).

This study examines the effect of consumption of large quantities of two kinds of low alcohol beer (0.5 vol.% and 0.9 vol.%) on the BAC of healthy, male volunteers.

Subjects and methods

The study was performed with 20 male volunteers aged 19–25 (average 21). A previous medical examination revealed no indication of any disease for any of them. The body weights of the test persons ranged from 65 to 84 kg (average 76), their lengths from 175 to 200 cm (average 186). Alcohol was avoided for 20 hours before the experiments.

For all test persons the distribution volume (WIDMARK’s r-factor) was calculated by WATSON’s method (WATSON, 1981). It ranged from 0.72 to 0.81 (average 0.76) which can be considered as normal for young men.

Protocol:

The volunteers were randomly divided into 2 groups (I and II) of 10 persons for a 2-hours drinking experiment. Both groups drank 2 liters of low alcohol beer during the 1st hour and 1 liter during the 2nd hour. The beer for group I and group II had an alcohol content of 0.9 vol.% and 0.5 vol.% respectively. The test persons were not informed about the alcohol content of the beer. Each study started at about 13.00 hr., the test persons had a small, standardised lunch at 12.00 hr. after having fasted since a normal breakfast between 7.30 and 8.30 hr. The experiments were repeated with the same group after 2 weeks under identical conditions. However, the beer for group I had an alcohol content of 0.5 vol.% and the beer for group II 0.9 vol.%.

Blood sampling:

In each study blood samples for determination of alcohol concentrations were taken from a catheter located in a forearm vein 20 minutes before and 20, 40, 60, 80, 100, 120, 140, 160,
and 180 minutes after drinking of beer. To avoid possible contamination the skin was previously cleaned with a non-alcoholic antibacterial solution. Samples (2 ml) of blood were stored in a glass tube (5 ml) with the addition of 40 mg sodium fluoride and 5 mg heparine, and analyzed for alcohol within 24 hours.

**Alcohol determination:**

The alcohol concentration in all blood samples was determined by the ADH-method. Each blood sample was measured in duplicate by two analysts working independently. This method has an accuracy of about 1% (standard deviation). The average value was calculated on the basis of 4 measurement results, where the following criteria applied:
- If the average value is less than 0.015 mg/mL, the result is considered as 0.
- If the average value is greater than or equal to 0.015 mg/mL, but less than 0.03 mg/mL, the result is recorded as ‘trace’.
- If the average value is greater than or equal to 0.03 mg/mL, the values are presented rounded off to the second decimal.

**Results**

**Alcohol contents of the beers:**

The brewers' information on the bottles (0.5 and 0.9 vol.% alcohol) of both types of beer was checked. After dilution, the alcohol content in the beers was determined by the same ADH-method used for the blood alcohol determination. On the basis of 4 randomly selected bottles the mean values obtained were 0.41 and 0.89 vol.%. Both results were within the specification of the brewer.

**Blood alcohol concentrations:**

The test persons who drank the 0.5 vol.%-beer exhibited no detectable BAC’s.

The BAC’s of the persons who drank the 0.9 vol.%-beer were only in a limited number of cases detectable and were below 0.1 mg/mL. The maximum BAC was found in subject S and measured 0.09 mg/mL. The results are summarized in table I.

The maximum BAC, if any, was reached at the end of the 2-hour drinking period. In none of the persons the maximum BAC was reached after the drinking period.

**Discussion**

Knowing the absolute amount (a) of alcohol consumed during the experiments, the values of WIDMARK’s factor (r) and the body weights (w) of the subjects, the maximum BAC can be calculated on basis of the WIDMARK-equation \[\text{BAC} = \frac{a}{r \times w}\] (WIDMARK, 1932). Substituting the average values of 0.76 for r and 76 kg for w, this equation gives a maximum BAC of 0.17 mg/mL. (for 0.5 vol.% beer) and 0.37 mg/mL. (for 0.9 vol.% beer) respectively. In this approach it is assumed a) that all alcohol is absorbed from the stomach and that the distribution over the body water is complete and b) that no alcohol elimination takes place. The design of the experiments led to a situation in which a large volume of low alcohol concentration was present in the subjects’ stomach. This condition is very unfavorable for a rapid resorption of the alcohol from the stomach. Since a considerable part of this alcohol will be eliminated before even entering the main blood stream (first-pass elimination), it explains why the calculated BAC’s are higher than the maximum BAC’S which were actually assayed: 0 and
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<th>subject</th>
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Table I Blood alcohol concentration (mg/mL) for drinking 0. g. vol.% beer during the experiments

0.09 mg/mL for 0.5 vol.% beer and for 0.9 vol.% beer, respectively. These results agree with those obtained by Luff and Lutz (1983).

Drinking 3 liters of low alcohol beer within 2 hours was experienced by all test persons as maximal. Therefore it can be concluded that the consumption of low alcohol beers, even in very large quantities, will only lead to very low BAC's (<0.1 mg/mL). This applies to 0.5 vol.% beer as well as to 0.9 vol.% beer. These BAC's have no significant forensic meaning.

It can be stated that drinking of low alcohol beers instead of traditional beer should have an important positive effect on traffic safety.

Summary
Drinking of 3 liters of so called low alcohol beer (0.5 vol.% as well as 0.9 vol.%) within 2 hours leads only to very low or no blood alcohol values during a drinking experiment (19 persons). These results are expected considering the kinetics of resorption and elimination of alcohol in human body. Consumption of low alcohol beers instead of traditional beer should have a positive effect on traffic safety.

Key words
low alcohol beer -- alcohol free beer, maximum blood alcohol concentration -- Widmark's equation

Acknowledgement
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Zusammenfassung
Der Konsum von 3 L. Bier mit geringer Alkoholkonzentration (0.5 und 0.9 Vol.%) innerhalb von zwei Stunden führte bei 19 Versuchspersonen zu sehr geringen oder auch keinen Blutalkoholwerten. Dies war bei Berücksichtigung des Alkoholstoffwechsels (Resorption und Elimination) im Körper des Menschen auch zu erwarten. Der Konsum von Bier mit geringem Alkoholgehalt anstelle von Bier mit der üblichen Alkoholkonzentration sollte einen positiven Einfluß auf die Verkehrssicherheit haben.
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Schlüsselwörter
Bier mit geringer Alkoholkonzentration – alkoholfreies Bier, maximale Blutalkoholkonzentration – Widmark Formel

Literature

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In lockerer Form, durch zahlreiche Karikaturen illustriert, wird hier das ganze Spektrum des Alkoholgenus­ses und seiner Folgen vor dem Leser aufgeblättert.

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