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Can Non-Alcoholic Beer Get You Drunk?



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ABSTRACT

In Japan, many different types of non-alcoholic beer, cocktails, and wine are sold. These are considered beverages that do not contain alcohol at all, and it is thought that there is no problem even if a child drinks them, regardless of the taste. In reality, non-alcoholic beer often contains small amounts of alcohol, and it is thought that drinking a large amount may cause intoxication. This is considered to be related to the manufacturing method. There are differences in the level of "drunkenness" that results from alcohol intake, and we here clarify that it seems to be mainly related to alcohol concentration in the brain, the criteria for crackdown when driving a car, and the relationship with drunkenness.



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INTRODUCTION

In Japan, so-called non-alcoholic beer, cocktails, wine, etc. have been sold in large numbers in recent years. From the name of non-alcoholic drinks, they can be considered as beverages that do not contain alcohol at all, and it is thought that there is no problem even if a child drinks them, regardless of the taste. The increase in these beverages seems to be due to the gradual revision of the law on driving a car and the stricter punishments for drunk-driving. For those who want to drink alcohol but need to drive a car, alcohol-free, similar-tasting beverages have been prepared instead. Does non-alcoholic beer really contain no alcohol and will not get you drunk even if you drink a lot? Is it okay for pregnant women and youths to drink? To clarify these questions, this study focuses on non-alcoholic beer-taste beverages and first investigated the classification. We also clarify the manufacturing method and give our opinion on the possibility of alcohol consumption. There are differences in the level of "drunkenness" that occurs when alcohol is ingested, and we also clarify that it is mainly related to alcohol concentration in the brain, the history of crackdown standards when driving a car, and the relationship with drunkenness.

Changes in definitions and classifications in Japan

Non-alcoholic beverages have a taste and aroma similar to alcoholic beverages, and most of them are beer-flavored beverages in Japan, but there are similar ones based on cocktails, wine, shochu highball, and sake. In Japan, "Amazake" (a sweet drink made from fermented rice) has long been consumed during the New Year. Because it is made from sake lees, it only has this name, and it contains almost no alcohol in contrast to the name. Therefore, it is considered appropriate for children to drink. Non-alcoholic beer is now more accurately called "beer-taste beverage" in the classification of beverages in Japan and elsewhere¹⁾. Although it is said that the name beer-taste beverages does not have a clear definition, it generally refers to a carbonated beverage that does not contain alcohol or the alcohol content is adjusted to less than a specific value, with a similar taste to beer. In Japan, according to the classification of the Liquor Tax Law, alcohol content of less than 1% is not a liquor but a beer-taste beverage. It seems that this is because it takes into consideration that it ferments naturally and unintentionally. Therefore, it is a mistake to say that beer-taste beverages do not contain alcohol. Elsewhere, low-alcohol beverages have been manufactured in Europe for many years and are used by many people¹⁾. Alcohol content of less than 0.5% corresponds to

"beer-taste beverage", and 0.6–0.9% is classified as an alcoholic beverage, and more specifically, a "low-alcohol beverage".

Some products currently sold in Japan contain an alcohol content of 0.00% to less than 1%. In Japan, the name and label of non-alcoholic beer was widespread until the early 2000s, and we are also familiar with this name. In reality, there are both products that contain alcohol at less than 1% and those that are considered to contain almost no alcohol. It was thought that consumers could misunderstand that this category was an alternative beverage to alcoholic beverages that did not contain any alcohol. Therefore, in 2004, the Fair Trade Commission issued a request for guidance on labeling optimization to affiliated companies and organizations; this changed the name and expression to beer-taste beverages, which continues to this day. Since only the name has changed, the situation where alcoholic beverages exist has not. If the alcohol content is said to be 0.00%, the product may be labeled a carbonated beverage on the container¹⁾.

Beverages with alcohol content very close to 0% are generally suggested not to be drunk during driving or between works. Therefore, they are often differentiated from beer-taste beverages with a higher alcohol content. In this case, a method of displaying a detailed value of 0.00% in the raw material display column to appeal is often used. By selecting products based on this, consumers will be able to select beverages that contain almost no alcohol.

Non-alcoholic beer manufacturing method

There are five main methods of manufacturing non-alcoholic beer known worldwide: the first is to make the beer first and then remove the alcohol¹⁾. This method is not used for domestic products in Japan, and it seems that these products distributed in Japan are limited to imported brands. When manufactured overseas, the method of distilling or evaporating alcohol was previously used for these products. In recent years, it has become possible to make low-alcohol beer by removing only the alcohol with a small molecular weight using semipermeable membrane filter technology, leaving the flavor component of beer with as large a molecular weight as possible while retaining the flavor of the original beer.

The second method is to remove impurities and add carbonic acid and other ingredients to the wort, which is made by saccharifying malt, adding hops, and boiling it, as in beer production²⁾. Many alcohol-free beers are made using this method in Japan. Third, there is also a method of adding various ingredients to the malt extract that can be obtained from malt

without using wort²⁾. Fourth, the same manufacturing method as beer is used, but the alcohol concentration is kept low during fermentation and adjusted to less than 1%¹⁾. The fifth method uses soft drinks and adds beer-like seasoning and flavors¹⁾.

Among these methods, it is highly possible that the alcohol content is not 0% in the first, second, and fourth. In the first method, the alcohol produced by fermentation is removed by a filter, but it may not be completely removed. The second method does not include yeast; however, other raw materials are included, so it is undeniable that a small amount of fermentation may proceed naturally to produce alcohol. Regarding the fourth method, fermentation seems to be controlled by the type of yeast, but a product containing a small amount of alcohol can be produced, as mentioned above.

Phenomena that occur in the body by alcohol intake

About 20% of the alcohol that enters through the mouth is absorbed in the stomach and the rest in the small intestine; this then enters the blood and spreads throughout the body in a few minutes. When alcohol in the blood reaches the brain, it acts on nerve cells in the brain, resulting in a lack of energy sources required for activity³⁾. It is said to suppress its function and paralyze it. Therefore, you become drunk. This is the mechanism of drunkenness (Table 1)^{4,5)}. Drunkenness is directly caused by the invasion of alcohol into the brain. Most of the alcohol absorbed in the body is metabolized and decomposed in the liver, and gradually disappears from the body. In the liver, it is decomposed into acetaldehyde, and then acetate⁶⁾. The acetic acid travels around the body by blood, is finally decomposed into water and carbon dioxide, and is excreted from the body via urine, sweat, and exhaled breath. Acetaldehyde is highly toxic, and if it is not sufficiently decomposed and remains in the body, it causes symptoms of headache and nausea. This is a hangover³⁾.

In such metabolism, it is thought that on average, approximately 0.1 g of alcohol can be decomposed in 1 h per 1 kg of bodyweight⁷⁾. As such, a human weighing 60 kg will be able to degrade alcohol at a rate of 5–9 g h⁻¹⁵⁾. If one bottle of beer (350 mL, 5%) is consumed, the blood alcohol will increase by about 0.02% and the exhaled breath will increase by 0.1 mg/L on average. This alcohol level is calculated to be completely decomposed in approximately 2 h. This is just an average; it is considered that there are individual differences in the concentration balance between the brain and blood and between blood and exhaled breath. It is well known that there are individual differences in this decomposition

rate, and it is thought that this determines a high or low alcohol tolerance. The enzyme that decomposes acetaldehyde is called ALDH2⁶⁾, and this enzyme has three genotypes: some people have a strong enzyme activity, some have a weak enzyme activity, and some have no activity at all⁵⁾. People with a high alcohol tolerance have an active form with a high metabolic rate of acetaldehyde; conversely, those who have a low active form with a slow metabolic rate or an inactive form with no enzyme activity have a low tolerance. This is determined by the combination of genes inherited from the parents and is not affected by the environment⁵⁾. It is said that about 38% of the Japanese are low active and about 7% are inactive. This is related to the fact that Japanese people are said to be more vulnerable to alcohol than Westerners. The inactive form is a characteristic found only in Asians, including Japanese, and it is known that there is no low/inactive form in Caucasians (white) and Africans (black)⁵⁾.

In addition to heredity, the difference in water content and body weight between individuals is naturally related⁵⁾. It is known that there are considerable differences in tolerance depending on gender, age, and physique. Women are generally considered to be more vulnerable to alcohol than men. It is said that the fundamental reason is that the amount of water in the body is less than that of men and that their physique and liver are smaller than those of men. Elderly people are considered to be more vulnerable to alcohol because they have less water in their bodies than do young people. People with a good physique generally have a larger liver, so it is thought that they have a faster metabolic rate and are more resistant to alcohol. In addition, since alcohol is difficult to dissolve in fat, it is considered that a person with a high body fat percentage has a lower proportion of water in the body than a person with a low body fat percentage, and the blood alcohol concentration becomes higher.

As mentioned above, alcohol is decomposed over time and converted into other substances. This will decrease drunkenness. Therefore, it is a mistake to say that alcohol does not remain on the next day, or that it recovers when sleeping, and decomposition does not proceed until time is up. If you drink alcohol late at night, you should consider that alcohol may remain until the next morning and your drunkenness may not have completely disappeared⁷⁾.

About the standard that you cannot drive a car after drinking alcohol

We will also discuss the laws related to driving a car, which is how non-alcoholic beer became popular in Japan⁹⁾. The Road Traffic Law was enacted in Japan in 1960. Before that,

driving while drinking alcohol did not violate the law (Table 2)^{9,10}. At the beginning of the enactment, there was an opinion of, "is it not overkill to ban all drink-driving?" Therefore, driving was banned only when the amount of alcohol in the exhaled breath was 0.25 mg/L or more (more than tipsy in Table 1). This seems to be because it was shown in experiments at that time that 0.15 mg or more of breath alcohol was associated with a decrease in athletic performance, and 0.25 mg or more of one was associated with abnormalities in mental and physical functions. At that time, there were no penalties for drunk-driving, but this could lead to the misunderstanding that it is okay to drive under the influence of alcohol, which is less than the standard value. In 1970, drunk-driving itself was prohibited regardless of the above standard value, and penalties (fines and deductions on the traffic violation point system) began to be imposed when the amount of breath alcohol was 0.25 mg/L or more (Table 2). In the latter half of the 1990s, an accident caused by a vicious drunk-driving occurred, and the movement to appeal for strict punishments became active mainly in the victims' families. The standard for the amount of exhaled alcohol was lowered in 2002, and the penalties became stricter. In addition, penalties have been strengthened in 2007 and 2009 (Table 2). It was thought that simply punishing a driver who was found to be drunk-driving would not eliminate drunk-driving, and it would be necessary to punish passengers and others. Therefore, new penalties were set for drivers' passengers when the penalties were strengthened in 2007.

It was made to be a violation to offer a car to a person who had been drinking, to serve liquor to a driver who was known to be driving a car later by a store employee, or to ask for a person to drive knowing that they had been drinking and then get in the car together⁹).

Under the Road Traffic Law, a violation is largely determined by the amount of alcohol in the exhaled breath; if the alcohol in the exhaled breath currently exceeds 0.15 mg/L, the person will be subject to penalties, regardless of whether or not they are aware that they are drunk¹⁰. As mentioned earlier, it cannot be said that the alcohol concentration in the exhaled breath and the concentration in the brain are completely correlated. Even if you are intoxicated at the penalty stage, it can be said that it is difficult to punish if the alcohol concentration is low. The actual penalty is carried out by inspections on the street, and equipment to measure alcohol exhalation is often used¹⁰. If this measurement exceeds the prescribed alcohol concentration, the punishment will be determined by the concentration and the level of intoxication. If the prescribed alcohol concentration exceeds the measurement of this device,

the punishment will be distinguished by the concentration and the level of intoxication (Table 2). Prior to these regulations, people working in the transportation industry, such as truck, bus, and taxi drivers, were taking care voluntarily. These jobs required the measurement of exhaled breath using an alcohol checker before driving.

CONCLUSION

This article ranges from non-alcoholic beer to penalties for drunk-driving. The first thing to keep in mind is that non-alcoholic beer often contains alcohol. Some may think that the value “0.00%” does not contain alcohol at all; however, mathematically, it can be considered that “less than 0.005%” is included. It should be understood that these beverages may contain only a small amount of alcohol. This is a little off topic, but in addition to shochu, which is popular in Japan, there is a product called "Hoppy", which has a beer taste, but also contains 0.8% alcohol¹¹⁾. It should be noted that many energy drinks, for nutritional tonicity, also contain alcohol. Next, in general, there is a numerical value in terms of how much alcohol you should consume to start feeling drunk, but you should be aware that this value is an average and includes exceptions. The activity of the enzyme that produces acetaldehyde has a genetic component. People with low enzyme activity decompose alcohol extremely slowly compared to those with normal enzyme activity, so the above-mentioned average value cannot be relied on. From these facts, it cannot be said that non-alcoholic beer is completely alcohol-free in many products, and it is better to consider that drinking these products by children and pregnant women requires caution. With regard to driving a car, there are situations in which the alcohol concentration in the exhaled breath is used as a criterion for whether or not the person is subject to punishment. Considering the intake, time elapsed after ingestion, genetic alcohol resolution, etc., it is better to consider it separately. Of course, it is not good to drink alcohol before driving, but it seems that various factors are involved in whether or not the intake of non-alcoholic beer is subject to punishment. In the services and parking areas on the highway, the sale of alcoholic beverages is prohibited from the viewpoint of not promoting drunk-driving; however, non-alcoholic beer with an alcohol content of 0.00% is now available for sale¹¹⁾. Additionally, some beer-taste beverage manufacturers in Japan have declared that there will be no problem with driving¹¹⁾. We think this is very dangerous and would like to advise that even 0.00% non-alcoholic beer should not be drunk by people with low alcohol tolerances⁸⁾.

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Table No. 1: Relationship between body alcohol concentration and drunkenness

Drunkenness	Blood alcohol concentration	Breath alcohol concentration	Estimated amount of drinking (beer)	Situation
Exhilarated	0.02%–0.04%	0.10–0.20 mg/L	<0.5 L	-Feel refreshed -Cheerful -Judgment becomes a little dull -Skin turns red
Tipsy	0.05%–0.10%	0.25–0.50 mg/L	0.5–1 L	-Feel tipsy -Hand movement becomes active -Unrestrained -Increased body temperature, faster pulse
Early drunkenness	0.11%–0.15%	0.55–0.75 mg/L	1.5 L	-Get upset -Loudly roar -Be angry -Stagger when standing
Intoxication	0.16%–0.30%	0.80–1.50 mg/L	2–3 L	-Become staggered -Say the same things over and over again -Breath faster -Nausea and vomiting occur
Drunk	0.31%–0.40%	1.55–2.00 mg/L	3.5–5 L	-Cannot stand properly -Language incorrect -Unconscious
Coma	0.41%–0.50%	2.05–2.50 mg/L	>5 L	-Does not wake up even when shaken -May release urine/feces -Breathing slowly and deeply -Sometimes die

Blood and exhaled alcohol concentrations are assumed immediately after drinking liquor, and the decrease in concentration due to metabolism that occurs overtime is not taken into consideration.

Average condition of Japanese people.

Based on data from reference 5).

Table No. 2: Penalties for driving a car when drinking liquor under the Road Traffic Law

Beginning of law enforcement	Prohibition contents* ¹	Breath alcohol concentration	Violation score* ²	Fine, etc.
1960	Drunk-driving	≥ 0.25 mg/L	No penalties	
1970	Drunk-driving	≥ 0.25 mg/L	15	Imprisonment for up to two years or a fine of up to 100,000 yen
	Driving under the influence of alcohol		6	Imprisonment for up to three months or a fine of up to 50,000 yen
2002	Drunk-driving	No concentration regulation	25	Imprisonment for up to three years or a fine of up to 500,000 yen
	Driving under the influence of alcohol	≥ 0.25 mg/L	13	Imprisonment for up to one month or a fine of up to 300,000 yen
		0.15–0.25 mg/L	6	
2007	Drunk-driving	No concentration regulation	25	Imprisonment for up to five years or a fine of up to 1,000,000 yen
	Driving under the influence of alcohol	≥ 0.25 mg/L	13	Imprisonment for up to three years or a fine of up to 500,000 yen
		0.15–0.25 mg/L	6	
2009	Drunk-driving	No concentration regulation	35	Imprisonment for up to five years or a fine of up to 1,000,000 yen
	Driving under the influence of alcohol	≥ 0.25 mg/L	25	Imprisonment for up to three years or a fine of up to 500,000 yen
		0.15–0.25 mg/L	13	

*1: Whether a person is driving under the influence of alcohol or drunk-driving is decided by a police officer who is inspecting for drunkenness by judging the symptoms of drunkenness, as shown in Table 1.

*2: Every time a driver causes a traffic violation or accident, violation points are accumulated, and when the total points for the past three years reach the maximum allowed, the license is suspended or revoked according to the total points.

Based on data from references 7) and 8).

