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Effects of low-deuterium liquor on human electroencephalogram and psychological function

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AbstractObjective To study the effects of low-dose or high-dose alcohol, ordinary liquor and low-deuterium liquor on the relative power of alpha waves on the electroencephalogram (EEG), alpha attenuation coefficient (AAC), subjective feeling and 5-hydroxytryptamine content in the blood after 8 consecutive days of intake, to explore the effect of low-deuterium liquor on the central nervous function of the human body and analyze its possible mechanism. Methods Eleven healthy adult males with an average age of 23.7 ± 1.3 years participated in this experiment. During the experiment, the subjects drank low-dose alcohol, high-dose alcohol, low-dose liquor, high-dose liquor, low-dose low-deuterium liquor and high-dose low-deuterium liquor respectively. After 30 minutes, the electroencephalogram (EEG) was detected, and the alpha attenuation coefficient (AAC) and alpha relative power value were calculated. The visual analogue scale (VAS) was used to test the comfort and work efficiency of the subjects as the subjective evaluation index, and blood samples were collected for the analysis of 5-hydroxytryptamine content. Results The results of ÿ attenuation coefficient showed that AAC increased after drinking high doses of alcohol, while no significant changes were observed in other groups. Compared with the control group, the average power value of ÿ wave decreased significantly after drinking high and low doses of alcohol and liquor, while the average power value of ÿ wave did not decrease significantly after drinking low-deuterium liquor, and was higher than that of the alcohol and liquor groups, indicating that drinking alcohol and liquor can reduce ÿ wave activity, while low-deuterium liquor has no such adverse reaction. The analysis results of plasma 5-hydroxytryptamine showed that the level of 5-hydroxytryptamine in plasma was the highest when drinking low-dose low-deuterium liquor, indicating that low-deuterium liquor can cause an increase in the comfort of the human brain. Conclusion Drinking alcohol and ordinary liquor can reduce the average alpha power value on the human electroencephalogram, reduce the human body's comfort and work efficiency, while low-deuterium liquor can maintain the human body's alpha wave relative power value, comfort, work efficiency and 5-hydroxytryptamine content at a higher level. That is, when drinking low-deuterium liquor, the function of the human central nervous system can be maintained at a relatively balanced and stable level, avoiding the occurrence of regulatory imbalance.

Keywords: alcohol, low-deuterium liquor, human electroencephalogram, 5-hydroxytryptamine

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Effects of Deuterium - Depleted Liquor on Brain and Psychological Functions. Shi Lu,Shen Caihong,Liu Hongtao,et al. Institute of Un-derwater Technology of Shanghai Jiao Tong UniversityÿShanghai 200231ÿChina

Abstract Objective To study the effect of deuterium ÿ depleted liquor on brain function and evaluate the regulation of central nervous system for deuterium ÿ depleted liquor in comparison with alcohol and ordinary Chinese liquorÿ Methods Eleven heathy adult male with an average age of 23ÿ 7 ± 1ÿ 2 participated in this experimentÿ The study was divided into seven experimental groupsÿsuch as normal control group (CK) ÿlow ÿ dose alcohol group (A ÿ L) ÿhigh ÿ dose alcohol group (A ÿ H) ÿlow ÿ dose ordinary Chinese liquor group (L ÿ L) ÿhigh dose ordinary Chinese liquor group(L ÿ H) ÿlow ÿ dose deuterium ÿ depleted Chinese liquor group(DDL ÿ L) and high ÿ dose deuterium depleted Chinese liquor group(DDL ÿ H) ÿ We recorded the electroencephalography(EEG) on Fzÿ ÿesults EEG showed that when sabiects drinking high or low doses of alcohol and ordinary Chinese liquorÿthe value of AAC had no significant change compared with the control groupÿ But the mean power of the alpha band decreased significantlyÿ Comparison with other groupsÿwhen subjects drinking high or low doses of the deuterium ÿ depleted Chinese liquorÿmean power of the alpha band increased significantlyÿ This phenomenon might be caused by deuterium ÿ depleted Chinese liquor biological activating effectÿ Compared with the control valueÿcomfort and work efficiency decreased when subjects drinking alcohol and liquor descendantsÿ The blood 5 ÿ hydroxytryptamine increased significantly when subjects drinking low ÿ dose deuterium ÿ depleted Chinese liquorÿ Conclusion This study demonstrated that compared with the alcohol and ordinary Chinese liquorÿthe deuterium ÿ depleted Chinese liquor induced pleasureÿincreased the intensity of the alpha waves on human EEGÿ

Key words Alcohol; Deuterium ÿ depleted Chinese liquor; Electroencephalography; 5 ÿ hydroxytryptamine

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Drinking is a common behaviour in daily life. Drinking in moderation can improve blood circulation, regulate human emotions, and enhance pleasure and comfort. Chinese liquor has a close relationship with water. For a long time, people have been concerned about how to use good water to improve the quality of liquor and reduce the harm of liquor to the human body. As we all know, water in nature is generally composed of 2 hydrogen atoms and 1 oxygen atom. Hydrogen atoms have 3 radioactive atoms with different masses. Nuclides: The mass of 1 is hydrogen (H), also known as protium; the mass of 2 is Heavy hydrogen (D), also known as deuterium; the mass of 3 is super tritium (T), also known as Tritium. The deuterium content in natural water is about 150ÿg/L, and the The content is very small. Previous studies have shown that deuterium is essential for the survival of life. Deuterium-depleted water has the effect of inhibiting cancer cells. Growth, radiation resistance, immune protection and enhancing human endurance This study intends to record and analyze the human electroencephalogram and blood 5-HT content in plasma, to explore the effect of low-deuterium liquor on the central nervous system of human body Functional regulation.

Objects and methods

1. Subjects: 11 male volunteers who passed the strict physical examination were selected as

The subjects were aged 21 to 25 years old, with an average age of 23.7 ± 1.3 years old. Degree: 5 are postgraduate students and 6 are undergraduates. Healthy, no neurological disease, visual, hearing and hand movement disorders, no Mental illness and non-smoking, the subjects did not take any drugs during the experiment Sedatives, do not drink stimulant drinks such as tea, coffee and alcohol, do not stay up late, and ensure sleep The experiment was conducted in a self-controlled manner. The subjects were informed of the purpose and methods of the study and the physiological and psychological tests they were required to take. Before the experiment, all participants were trained on the test content and methods. Keep quiet and

keep the temperature at 22 to 26ÿ. During the test, the subjects should sit quietly for at least After 10 minutes, lie down, close your eyes, relax, and breathe calmly.

2. Drinking reagents and experimental groups: (1) Drinking reagents: 52% homemade alcoholic beverage

The material is 96% edible alcohol (provided by Anhui Gujing Gongjiu Co., Ltd. 52% Luzhou Laojiao Special Qu (provided by Luzhou Laojiao Group Co., Ltd.); low-deuterium water (deuterium volume fraction 0.0050%) (provided by Shanghai Chitian Super Light Water Bioengineering Co., Ltd.).

(2) Experimental groups: This study was divided into 7 experimental groups, namely: ÿ Control (CK): Do not drink any alcoholic beverages; ÿ Low dose alcohol (A-L): Daily Drink 50ml of 52% alcohol + 200ml of ordinary drinking water; ÿ High dose of alcohol (A - H): Drink 100ml of 52% alcohol + 200ml of regular drinking water every day ÿLow-dose liquor (L-L): 50ml of 52% Luzhou Laojiao Special Liquor every day + 200ml ordinary drinking water; ÿ High-dose liquor (L-H): drink 100ml per day 52% Luzhou Laojiao Special Liquor + 200ml ordinary drinking water; ÿ Low-dose low-deuterium liquor (DDL-L): Drink 50ml 52% Luzhou Laojiao Special Liquor + 200ml Low Deuterium Liquor every day ÿ High-dose low-deuterium liquor (DDL-H): Drink 100ml 52% Luzhou liquor every day Laojiao Tequ + 200ml low-deuterium water. In the background experiment, volunteers were exposed to The volunteers in the remaining 6 groups will be required to Drink a prescribed amount of alcoholic beverage or wine (hereinafter referred to as the test substance) for 9 consecutive On the 1st, 4th, and 8th days of each experiment, volunteers drank The subjects were given the test substance and underwent EEG and psychological tests half an hour later.

3. Test method: (1) EEG recording method: using the Biopac

The MP30 system of the company recorded the electroencephalogram (EEG), with a time constant of 0.3s and a cut-off frequency. The frequency is 30Hz, and the Ag-AgCl disk electrode is placed in the international standard 10~20 system Electrode placement: Fz, Cz and Pz points, both above the right eyelid and below the outer canthus Two electrodes were placed to record the electrooculogram (EOG). Attenuation test (AAT) is to alternately open and close eyes for 1 minute to stimulate the central nervous system. Quantify the activity of the brain and evaluate the level of awakening of the human brain. The data of 1024 points were transformed into the fast Fourier transform (FFT) The ÿ wave intensity was divided by the ÿ wave intensity when the eyes were open to calculate the ÿ wave attenuation coefficient. Calculate the relative power value of ÿ wave. (2) Psychological test: Use visual analog assessment The visual analogue

scale (VAS) was used to measure the subjects'

(3) Analysis of serum 5-hydroxytryptamine: 5-hydroxytryptamine

The 5-HT test kit (provided by R&D Company, USA) provides the method for separation The 5-HT content in the serum of the subjects was analyzed.

3. Statistical methods: The experimental data were processed using SPSS 17.0.

Mean ± standard deviation (x ± s) indicates one-way analysis of variance. The differences in experimental data among the groups were considered statistically significant when P < 0.05. result.

1. Effects of different alcoholic beverages on the overall AAC of human EEG

Effects on the body: AAC levels are highest after drinking high doses of alcohol, There was a statistically significant difference between the CK group and the other groups (P ÿ 0.05).

The results are shown in Table 1.

Table 1 Overall effects of taking different alcoholic beverages on human EEG AAC

Group	Sample size	AAC
CK	11	1ÿ 38 ± 0ÿ 04
A ÿ L	11	1ÿ 39 ± 0ÿ 02
A ÿ H	11	1ÿ 45 ± 0ÿ 03*
L - L	11	1ÿ 42 ± 0ÿ 02
L ÿ H	11	1ÿ 42 ± 0ÿ 02
DDL ÿ L	11	1ÿ 41 ± 0ÿ 03
DDL ÿ H	11	1ÿ 44 ± 0ÿ 02

Compared with the CK group, * P ÿ 0.05

2. Effects of different alcoholic beverages on the relative function of alpha waves n human EEG

Effect of rate value: After drinking alcohol and ordinary liquor, the human body At low or high doses, the relative power of alpha waves in the electroencephalogram (EEG) After drinking low-deuterium liquor, the ÿ wave power The values were not significantly different from those in the CK group, and were higher than those in the alcohol and liquor groups.At the same time, there was no statistical difference between the high-dose and low-dose groups.

The results are shown in Table 2.

Table 2 Effects of taking different alcoholic beverages on the relative power value of ÿ in the human body

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Group	Sample size	ÿ Relative power value
CK	11	0ÿ 75 ± 0ÿ 21
A ÿ L	11	0ÿ 66 ± 0ÿ 08*
A ÿ H	11	0ÿ 55 ± 0ÿ 14*
L - L	11	0ÿ 70 ± 0ÿ 08*
L ÿ H	11	0ÿ 69 ± 0ÿ 03*
DDL ÿ L	11	0ÿ 82 ± 0ÿ 08ÿ
DDL ÿ H	11	0ÿ 78 ± 0ÿ 11ÿ

Compared with the CK group, * P ÿ 0.05; compared with the A-L, A-H, L-L, and L-H groups

Ratio, ÿ P ÿ 0ÿ 05

3. Effects of taking different alcoholic beverages on human subjective evaluation:

(1) Effects of taking different alcoholic beverages on comfort: Compared with the CK group Compared with the control group, the high-dose alcohol group and the high-dose liquor group had a significantly higher sense of

comfort. There was no statistical difference among the other groups. It means that after taking the same dose of low-deuterium liquor, the human body's comfort level did not decrease. The results are shown in Table 3. (2) Effects of taking different alcoholic beverages on work efficiency Effect: The study showed that compared with the CK group, the high-dose alcohol group, the high-dose The work efficiency of the liquor group and the high-dose low-deuterium liquor group was significantly reduced (Pÿ 0. 05); Compared with the low-dose alcohol group, the high-dose alcohol group had a The rate of leukemia decreased significantly (P ÿ 0.05). Compared with the low-dose liquor group, the high-dose liquor group The work efficiency of the group that drank a large amount of liquor decreased significantly (P < 0.05).

There was no statistical difference between the two groups, and the results are shown in Table 4.

Table 3 The overall effect of taking different alcoholic beverages on human comfort

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Group	Sample size	Comfort
CK	11	5ÿ 95 ± 2ÿ 04
A ÿ L	11	4ÿ 65 ± 1ÿ 69
A ÿ H	11	4ÿ 20 ± 1ÿ 97*
L - L	11	4ÿ 92 ± 1ÿ 92
L ÿ H	11	4ÿ 37 ± 2ÿ 24*
DDL ÿ L	11	5ÿ 12 ± 1ÿ 74
DDL ÿ H	11	4ÿ 71 ± 2ÿ 09

Compared with the CK group, * P ÿ 0.05

Table 4 Overall effects of taking different alcoholic beverages on human work efficiency

Group	Sample size	Work efficiency
CK	11	5ÿ 88 ± 1ÿ 42
A ÿ L	11	4ÿ 92 ± 1ÿ 39
A ÿ H	11	3ÿ 98 ± 1ÿ 69ÿÿ
L - L	11	5ÿ 13 ± 1ÿ 58
L ÿ H	11	3ÿ 92 ± 2ÿ 34* #
DDL ÿ L	11	4ÿ 68 ± 2ÿ 05
DDL ÿ H	11	4ÿ 38 ± 2ÿ 07*

Compared with the CK group, * P ÿ 0.05; compared with the A-L group, ÿ P ÿ 0.05; compared with the L-L group

4. Effects of different alcoholic beverages on the content of 5-hydroxytryptamine in human serum

Effect of dosage: The serum 5-HT content in the low-deuterium liquor group was the highest. The results were shown in Table 5.

Table 5 Effects of different alcoholic beverages on serum

Effects of 5-HT Levels

Group	Number of samples 5 - Serotonin (ng/L)	
CK	11	1196ÿ 91 ± 477ÿ 80
A ÿ L	11	1115ÿ 93 ± 400ÿ 26
A ÿ H	11	1483ÿ 32 ± 499ÿ 09
L - L	11	1332ÿ 22 ± 493ÿ 94
L ÿ H	11	1490ÿ 82 ± 653ÿ 89
DDL ÿ L	11	1201ÿ 21 ± 563ÿ 60
DDL ÿ H	11	1614ÿ 68 ± 469ÿ 10ÿ

Compared with the CK group,ÿ P ÿ 0ÿ 05

discuss

A large number of epidemiological studies have shown that moderate drinking is

For people who do not drink or drink excessively, the risk of dementia can be significantly reduced. risk, increase brain cognitive function, and reduce the risk of cardiovascular disease Risksÿ4ÿ8ÿ. EEG is an objective indicator of brain function. Its waveform and amplitude Changes in frequency can reflect changes in brain

function. In the case of , the EEG is dominated by ÿ waves, and when the person opens his eyes, Due to the stimulation of light and external environment, the alpha wave on the EEG decreases, A large number of beta waves appear, which is a sign of increased brain arousal. It is pointed out that the concept of alpha attenuation coefficient (AAC) was first proposed by Michimori et al. [9] proposed this. They conducted an alpha attenuation test (AAT) and found that when the arousal level of the human brain When the level rises or falls, the AAC changes accordingly. The magnitude of this change can be used to quantitatively assess central nervous system function Studies have reported that drinking alcohol can cause peripheral movement and changes in autonomic nervous system function due to alcohol acting on brain cells. Causes changes in the metabolic function of nerve cells and the conduction velocity of nerve fibers. This leads to changes in brain bioelectricity, with a decrease in alpha waves and an increase in beta waves. Diffuse mild EEG changes. And the longer the alcohol dependence period, The more alcohol you drink and the more often you drink, the more abnormal your EEG will be.High [10-12]. When drinking a large amount of alcohol, the brain bioelectric waves will slow down and the heart rate will Alcohol is not only a depressant of the central nervous system, but also It is a stimulant for cardiac conduction. Drinking a lot of alcohol can cause dysfunction of the nervous system. Functional impairment and myocardial ischemiaÿ13ÿ.

The results of this study showed that after drinking alcohol, the alpha

The wave attenuation coefficient increased significantly in the first group, but no significant changes were found in the other groups. This indicates that high doses of alcohol can cause central nervous system excitability in the human body. This phenomenon was not observed when drinking the same dose of liquor and low-deuterium wine. The occurrence of a small amount of alcohol intake can cause the EEG signal in the front of the head to In the 4 to 30 Hz EEG frequency band, ÿ waves are usually The strongest component is also the main component that shows brain function. The results showed that when drinking alcohol and liquor, the alpha waves in the frontal head decreased. However, no decrease in alpha waves was observed when drinking deuterium-depleted wine compared with the control value. It should also be noted that alpha waves on the EEG are associated with memory, cognitive ability, Studies have shown that ÿ waves are related to various brain functions such as information processing. The memory is better when the relative power value is high than when the relative power value is low [14].

Drinking alcohol not only affects the physiological functions of the human

body, but also has an impact on psychological functions.

After drinking a small amount of alcohol, people will feel relaxed and comfortable. Comfortable, but as the amount of alcohol increases, its psychological function gradually changes. Moderation is the physiological and psychological satisfaction people feel after drinking. Generally speaking, the human body's comfort level is determined by the degree of alcohol consumption. The influence of various factors and conditions such as ingredients, taste, alcohol content and drinking volume.

Comfort will also show different results due to individual differences. The results of this study show that the comfort level is the highest after drinking low-dose low-deuterium high-end liquor, with an average of more than 5.1, while the comfort level of the human body decreases when drinking high-dose alcohol and liquor. Work efficiency refers to the ratio of work input to output, which is closely related to people's desire and enthusiasm for work. The author's research results show that there are obvious differences in work efficiency when drinking different doses of various alcohols. The low-dose group has high work efficiency. At the same time, compared with the control group, the work efficiency is significantly reduced when drinking high doses of alcohol and liquor, while there is no decrease in work efficiency when drinking low-deuterium liquor. As an important neurotransmitter, 5-hydroxytryptamine is a messenger that can make people feel happy and affects almost every aspect of brain activity. People with low 5-hydroxytryptamine levels are more likely to have depression, impulsiveness and other behaviors. Our research results show that the 5-hydroxytryptamine content in serum is significantly increased after taking high doses of low-deuterium liquor ($P < 0.05$). This also suggests that the higher sense of comfort after drinking low-deuterium liquor may be related to the increase in 5-hydroxytryptamine content in the blood. Chinese liquor is a treasure of the Chinese nation and an important part of China's thousands of years of culture. For a long time, due to the social harm caused by excessive drinking, people have exaggerated the harmful effects of liquor, while the understanding and research on the health effects of liquor are insufficient. I believe that with the deepening of research, the development of healthier liquor and the advocacy of healthier drinking methods will surely inject vitality into China's liquor industry.

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