Behavioral and Electrophysiological Analysis of Anxiolytic Effect of Mongolian Astragalus

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Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 125, No. 4, pp. 407-409, April, 1998
Original article submitted March 21, 1997

Medical herb Mongolian astragalus has anxiolytic activity in conflict situation imposed on random-bred male albino rats, and evokes changes in electroencephalogram which are characteristic of tranquilizers. The drug moderates the τ-rhythm in cerebral hemispheres and hippocampus. In contrast to benzodiazepine tranquilizers, it does not affect the frequencies in other bands.

Key Words: *medical herbs; anxiolytic effect; conflict situation; electroencephalogram*

Medical herbs are widely used in the therapy of neurotic and borderline-neurotic states as sedative [4] and supporting [2] preparations. Since the drugs used in the treatment of these diseases produce unfavorable side-effects, some medical herbs may be prospective as minor daytime tranquilizers.

This paper deals with anxiolytic effect of Mongolian astragalus (MA), which is a herb of the leguminous family growing in Russia and Mongolia. The mechanism of MA action was examined by analysis of changes in the electroencephalogram (EEG).

MATERIALS AND METHODS

The study was carried out on random-bred male albino rats weighing 200-250 g.

Anxiolytic activity was examined on the model of conflict situation based on antagonism (conflict) of drinking motivation and electrical nociceptive stimulation [12]. The study used a multichamber setup developed at the Laboratory of Psychopharmacology of the Institute of Pharmacology, Russian Academy of Medical Sciences [6]. After deprivation and conditioning to drink from a drinking bowl, the rats were arbitrary subdivided into the following groups: nonpunished control group, in which rats were given distilled water with no electrical current applied to the drinking bowl (this group was used to estimate motor activity and drinking motivation on the day of experiment); punished control group, in which rats were given water, but electrical current was applied to the drinking bowl; three groups of rats, in which MA was administered in increasing doses; and three groups of rats, in which increasing doses of phenazepam (a control drug) were given. The effect was evaluated by statistically significant increase in the number of punished water takings in the control group rats in comparison with the punished control group at an electrical current strength of 0.5 or 1 mA. The effects of preparations on motor activity were assessed visually by the number of crossings of the lines, which were drawn on the floor under the electrode wires spaced at 5 cm [5].

The EEG was recorded under unrestrained behavioral conditions from the rats in which Nichrome electrodes were implanted into the hippocampus and frontal cortex under local anesthesia and Nembutal narcosis (40 mg/kg). The reference electrode was fixed in the nasal bones. On postoperative days 7-10 (restoration period surgery operation and narcosis) the EEG was recorded with the help of a Neurograph 18-channel electroencephalograph (O.T.E. Biomedica), with amplifiers tuned for the standard modes of recording (time constant 0.3 sec, upper boundary frequency 32 Hz). The signals were fed to a 12-bit digitizer (L-Card) and processed in a computer with the help of a BrainSys software (Hard-Soft). The

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0007-4888/98/0004-0358$20.00

effects of the drugs on the power of spectra EEG from frontal cortex and hippocampus were evaluated in the frequency band of 0-32 Hz.

The rats were conditioned to experimental surroundings. The background EEG was recorded during 5 min, then MA was administered intragastrally, and EEG was recorded every 15 min during the first hour and then during every hour. The effects of MA were compared with those of the tranquilizer phenazepam.

RESULTS

Mongolian astragalus produced a pronounced anxiolytic effect on the behavior of rats in the conflict situation.

In the nonpunished control group the number of water takings varied from 390 to 750, being accompanied by high motor activity, which testifies to strong drinking motivation and normal state of the rats. When the nociceptive stimulation was applied (electric current given to the drinking bowls in the punished control group), the number of punished water takings decreased, varying from 8 to 26. The nociceptive stimulation moderated motor activity of the rats as compared with the non-punished rats, and it was virtually absent at the end of the observation period. Intragastrid administration of 3 and 5 g/kg MA modified the behavior of the rats. In spite of electrical current shocks, which accompanied every water taking, they proceeded drinking from the bowl. The number of punished reactions in these rats was significantly increased as compared with that in the punished control rats (Table 1). These data demonstrate anxiolytic activity of MA in the doses of 3 and 5 g/kg. In these rats motor activity was maintained at a high level, which testifies to noninhibitory effect of MA. The effect of 5 g/kg MA was similar to that of the tranquilizer phenazepam given at a dose of 1 mg/kg (Table 1). However, phenazepam inhibited motor activity during testing. When the dose of MA was increased to 10 g/kg, its anxiolytic effect decreased, but motor activity remained at a high level. Given in a dose of 7.5 mg/kg, phenazepam markedly increased the number of punished reactions against the background of motor activity decreased in comparison with the control. An increase in the phenazepam dose to 10 mg/kg attenuated its anxiolytic effect, which was accompanied by moderation of motor activity due to enhanced sedative effect of the drug. The data show that in contrast to phenazepam, attenuation of the anticonflict effect of MA was not caused by enhancement of sedative effect (Table 1). The anxiolytic effect of MA was not observed when the strength of electrical current was increased to 1 mA.

The study of MA effect on bioelectrical activity showed that in the dose of 5 g/kg it markedly modifies the EEG: spectral power of the τ-rhythm decreased, while other frequency bands remained practically unchanged (Fig. 1, *a*). Mongolian astragalus affects both sensorimotor cortex and hippocampus. Its effect was detected 30-45 min after administration. It lasted 2-3 h and peaked on the 60th-90th min. Phenazepam also decreased spectral power of the τ-rhythm, and increased the power in δ and β frequency bands (Fig. 1, *b*).

Thus, the medical herb MA has profound anxiolytic activity, which was revealed in a modeled conflict situation. The anticonflict effect of MA (5 g/kg) was comparable to that of the tranquilizer phenazepam in a dose of 1 mg/kg. In contrast to this drug, MA does not affect motor activity during conflict situation and loses its activity at increased strength

TABLE 1. Effect of Mongolian Astragalus (MA) on Rat Behavior in Conflict Situation ($M \pm m$)

Groups of rats, doses			Number of water taking	Number of displacements
Control				
	non-punished	—	645.9±73.1**	19.7±3.5
	punished	—	22.57±10.1	5.4±3.1+
MA,		1.5	28.13±7.8	16.3±3.8
		3	56.67±21.5*	18.5±4.1
		5	136.67±85.1*	19.2±3.6
		10	38.86±14.9	18.5±4.3
Phenazepam,		1	167.4±89.4*	10.4±3.1+
		7.5	427.4±53.9**	12.5±3.3+
		10	326.7±49.1**	5.9±2.8+

Note. Doses of MA and phenazepam are given in g/kg and mg/kg, respectively. *$p<0.05$ and **$p<0.01$ compared with punished control group; +$p<0.05$ compared with nonpunished control group.

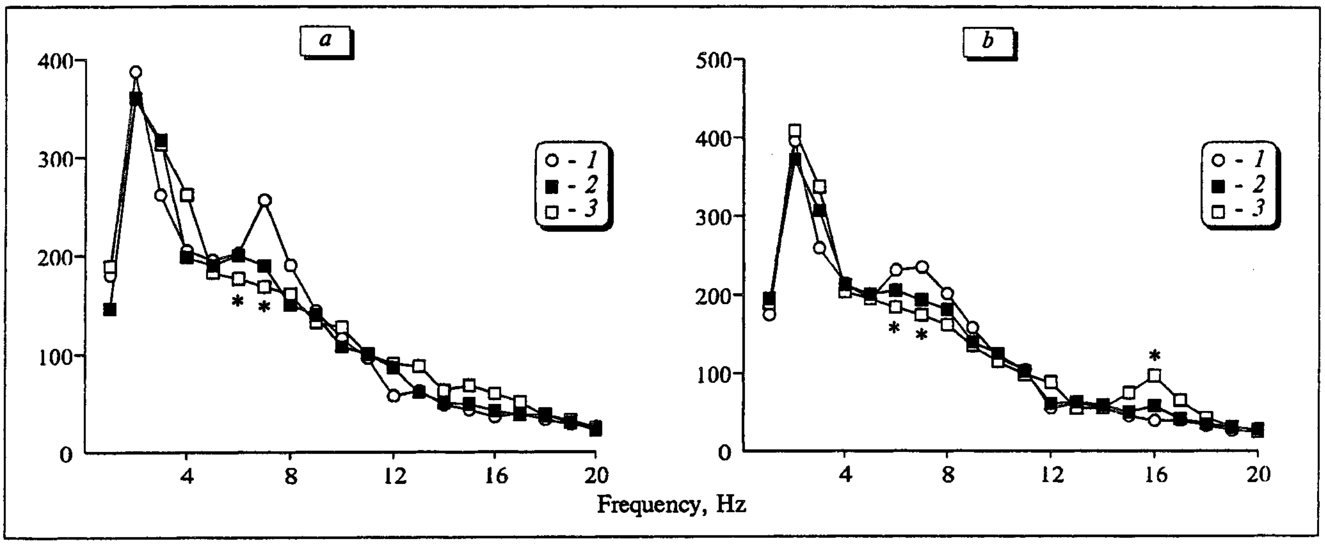

Fig. 1. Changes in spectral power of hippocampal electric activity under the action of (*a*) Mongolian astragalus (MA) and (*b*) phenazepam. Ordinate: spectral power in μV². The EEG power spectra (*1*) before administration of the drugs, (*2*) 90 and (*3*) 180 min after administration of (*a*) MA (3 g/kg) and (*b*) phenazepam (1 mg/kg). $^*p<0.05$ in comparison with the control group.

of the punishing electrical current. In this respect it demonstrates the properties of a minor daytime tranquilizers [7]. Electrophysiological analysis has shown that the mechanism of anxiolytic action of MA is determined by its selective effect on the τ-rhythm without modification of other EEG bands. Attenuation of the τ-rhythm is related to the anxiolytic effect of tranquilizers [1], while the increase in spectral power of δ and β bands, which is characteristic of potent tranquilizers, including phenazepam [8], correlates with their sedative activity [3,9-11].

Thus, MA exhibits anxiolytic activity in conflict situation and modifies the EEG in similar to tranquilizers producing selective anxiolytic effect.

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