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Full Length Article

The essential oil of rosemary and its effect on the human image and numerical short-term memory

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ABSTRACT

The research results of the effect of essential oil of rosemary on the human short-term image and numerical memory have been described. The study involved 53 secondary school students (24 boys and 29 girls) aged 13–15 years, residents of the Ukrainian metropolis. Participants were divided into the control group and “Rosemary” group, in which the rosemary essential oil was sprayed. The statistically significant differences in productivity of the short-term memory of the participants of these two groups have been found, while sex differences in uniform groups were absent. Therefore, the essential oil of rosemary has significantly increased the image memory compared to the control. Inhalation of the rosemary essential oil increased the memorization of numbers as well.

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1. Introduction

In today's world there are many factors that adversely affect the human mental health. The number of children with the attention deficit hyperactivity disorder has increased, and among adults the cases of Alzheimer's disease have become more frequent. Therefore, not only identification of risk groups by such important characteristics as memory, attention and the response rate, but also the study of the possibilities of their correction are relevant. It is desirable to use natural compounds with a decreased risk of side effects compared to synthetic components of drugs. Considering the current methods of alternative medicine aromatherapy is highly popular and reasonably trustworthy among the professionals. The topicality of studying the effects of essential oils is induced by a number of advantageous points, namely, the relatively high rate of their impact, ease of use, safety and relatively low costs. Essential oils are used for various purposes: skin cleansing and skin tonicity, hair wetting and hair nourishment, wellness massage and psychophysiological effects [1].

The knowledge of the biological effects of many essential oils was passed on from generation to generation mainly through just observations without scientific evidence. For example, it is considered to be traditional that the essential oils of rosemary and peppermint have the stimulating effect on the central nervous system, and the essential oils of ylang ylang and lavender, vice versa, exhibit the sedative effect. The current studies, which allow

selecting specific combinations of essential oils, are able to explain their biological activity previously perceived *a priori*. Thus, the rosemary essential oil is used in aromatherapy for a relatively long time; however, its effects on the human body, particularly on the nervous system, have not been sufficiently studied. In one study involving 20 healthy volunteers who inhaled the rosemary essential oil the subjective feelings of the participants and objective indicators of the autonomic nervous system (the body temperature, the heart rate, the rate of respiration and blood pressure) were assessed. The electroencephalogram was also taken in the participants of the study. The measurements were performed before, during, and after inhalation of the essential oil. The results demonstrated a significant increase in blood pressure, the heart rate and the rate of respiration after aromatherapy. The volunteers noted that they felt more refreshed. Analysis of EEG also showed the stimulating effects of the rosemary essential oil on the brain wave activity [2].

The effects of aromatherapy were studied in the elderly, some of them suffered from Alzheimer's disease. The aromatherapy lasted for 28 days. For the experiment the essential oils of rosemary and lemon were used in the morning, while the essential oils of lavender and orange were used in the evening. The results of the study showed a positive effect of the aromatherapy on cognitive indices of the participants of the study [3]. The studies were conducted to assess the effect of 1,8-cineole containing in the rosemary essential oil on the cognitive performance and mood of a person. The study involved 20 healthy volunteers. Before and after the experiment the cognitive indices and the mood change were assessed in points. At the end of the experiment the subjects were

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Table 1
The age characteristics of the sample under study.

Group	n	\bar{X}	δ	min	max	W	p	D	p
Control	31	13.8	0.7	13	15	0.79	<0.001	0.28	<0.01
Rosemary	22	14.1	0.5	13	15	0.70	<0.001	0.39	<0.01

Notes. n – number of participants, \bar{X} – mean, δ – standard deviation, min – minimal value, max – maximal value, W – the Shapiro-Wilk test, D – the Kolmogorov-Smirnov test, p – significance level.

Table 2
Sex of participants of the study.

Group	Males, n (%)	Females, n (%)	Total
Control	12 (38.7)	19 (61.3)	31
Rosemary	12 (54.6)	10 (45.5)	22
Total	24	29	53

χ^2 (with Yates' correction) = 0.74, p > 0.05.

Notes. n – number of participants, χ^2 – the chi square test, p – significance level.

taken the venous blood for determining 1,8-cineole in the serum. The results obtained showed that the concentration of 1,8-cineole absorbed into the bloodstream by inhalation of the rosemary essential oil was positively associated with the effectiveness of the tasks proposed. It was also shown that the rosemary essential oil contributed to improvement of the speed and accuracy of task performance. The effect of the essential oil on mood was not particularly noticeable [4].

Not only the inhalation of essential oils can have a positive impact on memory in human and animals. It was shown in rats that the subchronic administration of the rosemary extract of *Rosmarinus officinalis* L. per os in the dose of 200 mg/kg improved the long-term memory in rodents on the background of introduction of scopolamine alkaloid. The hypothetical mechanism of action, which was the basis of the memory improvement, was the inhibition of acetylcholinesterase in the rat's brain [5]. In another work the effects of different doses of the rosemary extract introduced to male rats of Wistar line (50, 100 and 200 mg/kg/day) within 12 weeks on learning and the spatial memory, as well as on the survival of neurons in the hippocampus (the region of the brain being responsible for transition of the short-term memory into the long-term one, or the so-called consolidation), were studied. According to the results of the study the extract of rosemary in the dose of 100 mg/kg contributed to restoration of the information retrieval from the memory. The effect of the plant extract in higher doses was less pronounced [6]. In the elderly at the age of 75 at the beginning of the study the use of the powder from rosemary dry leaves in different doses affected the memory rate in various ways. The rosemary powder had a positive effect in the lowest dose (750 mg), and it had a negative impact on this process in the highest dose (6000 mg). The conclusion about the positive effects of small chronic doses of rosemary, which were similar to those used in cooking, was made [7]. It is expected that diterpenes contained in rosemary inhibit the death of neurons induced by a

number of factors *in vitro* and *in vivo*, thus presenting the therapeutic potential when treating Alzheimer's disease [8].

There is evidence that preferences to essential oils may be related to gender and ethnicity. Thus, in one study the attractiveness of the essential oil among Hispanic and white secondary school students was assessed. The results of the study demonstrated that inhalation of the essential oil of orange was associated with happiness in girls. In addition, Hispanic girls considered the odor of the essential oil of orange to be soothing more often than white girls. On the other hand, Latin American males described the odor of peppermint as "energetic" more often than white students [9].

Ukraine is a multiethnic state [10–14]. As shown by our previous studies, the Ukrainian population is polymorphic by the taste sensitivity [15] and is characterized by a peculiar sexual dimorphism and unique distribution of a number of behavioral characteristics [16,17]. It is expedient to study the possible effects of different factors, in particular the effect of essential oils, on cognitive features of the Ukrainian population previously unstudied in this respect. The aim of the present study was to analyze the effect of the essential oil of rosemary on characteristics of short-term image and numerical memory of secondary school students living in the modern Ukrainian cities.

2. Materials and methods

The study involved 53 secondary school students (24 boys and 29 girls) aged 13–15 years. The volunteers were natives of the city of Kharkiv – the second largest metropolis of Ukraine. All participants of the experiment were divided into two groups in a random manner. The first group was the control group where the students were not exposed to any essential oils. In the second group ("Rosemary") the rosemary essential oil was sprayed (the Latin name of appropriate plant used is *Rosmarinus officinalis* L.). The control group included 31 individual (12 males and 19 females) and the experimental group included 22 individuals (12 males and 10 females). The participants of the study were not informed about the presence of aromas of the essential oil in the room. The collection of information was conducted taking into account the ethical principles when dealing with a person in accordance with the Declaration of Helsinki. All participants of the experiment gave the written consent to participate in the study, completed the questionnaire, which included a list of issues of the demographic nature, and their cognitive features were tested.

Table 3
Basic statistical parameters of correctly reproducible images and numbers as indicators of short-term memory.

Group	n	\bar{X}	$s_{\bar{X}}$	δ	min	max	Q ₁	Me	Q ₃
<i>Correctly reproducible images</i>									
Control	31	7.2	0.4	2.3	2	12	5	7	9
Rosemary	22	9.4	0.5	2.3	5	13	8	9.5	11
<i>Correctly reproducible numbers</i>									
Control	31	5.8	0.3	1.8	2	9	4	6	7
Rosemary	22	7.1	0.4	1.9	4	11	6	7	9

Notes. n – number of participants, \bar{X} – mean, $s_{\bar{X}}$ – standard error, δ – standard deviation, min – minimal value, max – maximal value, Q₁ – lower quartile, Me – median value, Q₃ – upper quartile.

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