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ESSENTIAL OILS: PSYCHOPHYSIOLOGICAL REACTION AND CHANGES IN COGNITIVE PROCESSES

This article presents the results of the research of specificity of psychophysiological reactions and changes in the cognitive processes as a result of using ephemeral oils by means of a classical experimental study with the use of a polygraph. Theoretical analysis of scientific publications of recent years on this topic was carried out. The scientific novelty of the research consists in specifying the effects of different types of ephemeral oils, determined by their complex influence – activity or quiescence. The effect of stimulating and sedative essential oils on the processing of cognitive processes and changes in the human body, as well as the effect on these characteristics of the subjective perception of the fragrance. As a result, significant differences in the speed of cognitive processes depending on the type of ether oils and associated psychophysiological reactions were revealed. Specifically, the activation of the nervous system in the inhalation of stimulating oils with a decrease in the speed of thought processes and a decrease in concentration, and the opposite effect in the action of sedative oils.

Keywords: essential oils, cognitive processes, psychophysiological reactions, polygraph.

Problem Statement. The history of the use of essential oils dates back to about 5,000 years ago and is closely linked to China and Egypt. At that time, oils were used not only for embalming the body, but also as antiseptics, in the construction of pyramids and wound healing. Since the end of the last century, there has been a growing interest in scientific community in aromatherapy, a form of alternative medicine that uses plant essential oils. This is accompanied by the increase in scientific work on "essential oils", "aromatherapy" and the study of their effects on the human body and psyche. In the literature of the 90s of the last century you can find descriptions of the complexity of finding relevant sources on this topic, now it is invisible. According to experts, the volume of the aromatherapy market is growing by 6-8 % every year. It happens due to the growing demand for organic products and the growing embarrassment of people's own health. A busy lifestyle encourages consumers to turn to a quick and evidence-based way to resolve situational queries. Therefore, due to the high popularity of this product, the interest of scientists in the effectiveness and feasibility of its use increased. There is very little work that would gather a larger array of information that would combine research on the effect of essential oils at different levels of perception – physiological and mental. In particular, there is a gap in research related to cognitive processes and their speed, depending on the use of different types of oils, particularly, sedatives and stimulants. Therefore, this work is an attempt to summarize the material developed on this topic so far and to expand knowledge about the influence of essential oils on psychophysiological reactions and cognitive processes.

The aim of this article is to investigate the dynamics of psychophysiological response and changes in cognitive processes as a result of the use of essential oils. Particular attention was paid to the symptom complexes of sedative and stimulating effects of oils and the speed of cognitive processes. The study used the design of a classical experiment, involving the control and two experimental groups. The practical value of the results lies in justifying the use of

essential oils and clarifying the feasibility of their practical use in accordance with the expected impact. The increase in the speed of cognitive processes and the activation of the sympathetic nervous system, which will be observed in the corresponding physiological reactions, will indicate the effectiveness of stimulating oils, and the opposite reaction, the effectiveness of sedative oils.

Literature Review. Essential oils are volatile, natural complex compounds that have a strong odor and are formed in aromatic plants as secondary metabolites. The International Organization for Standardization [6] has defined essential oils as "a product obtained from natural raw materials of plant origin, prepared by the steam distillation, after separation of the aqueous phase." Inhalation and external use of these oils are the basis of aromatherapy – the therapeutic use of aromatic oils of plant origin to improve physical and spiritual well-being (The American Heritage® Medical Dictionary). In recent years, this type of alternative medicine has become quite popular.

The formation of the effects of odors of aromatic substances on the physiological systems of the body is due to changes in the neurophysiological activity of the structures of the limbic system, the inclusion of the pituitary-adrenaline system. These effects are largely due to the multicomponent composition of the odor, close in chemical structure and biological action to endogenous compounds involved in the bioregulation of physiological systems of the body [10, c. 1332]. To describe the mechanisms of the effect of aroma on the human body, two hypotheses were proposed – pharmacological and psychological [4, c. 36]. This distribution emphasizes the effect of essential oils at different levels of odor perception.

The pharmacological hypothesis assumes that the influence of different aromas on mood, physiology and behavior is due to the direct and intrinsic ability of the odor to interact and affect the autonomic nervous system/central nervous system and/or endocrine system. In order to study this effect based on the fixation of physiological changes in the body under the influence of essential oils, the dynamics of changes in brain

wave activity [7, 8], heart rate [15], and skin conductivity [11, 9] are estimated. The overall results of these studies showed that the stimulating effect of oils increases heart rate and electrodermal activity, activates beta and suppresses theta rhythms of the brain. Sedation reduces skin conduction and pulse, stimulates alpha and theta rhythms.

The psychological hypothesis is not the opposite of the pharmacological one, but rather complements it. It suggests that odors affect emotional learning, conscious perception, and beliefs/expectations. The central statement of the psychological hypothesis is that reactions to odors are studied through association with emotional experiences, and that they acquire the properties of related emotions and themselves exert concordant emotional, cognitive, behavioral, and physiological effects [4]. Olfactory efferents have a unique direct connection with the neural substrates of emotional processing and memory processing. Therefore, an approval or dislike of the aroma is directly related to the fact that there is a change of mood. For example, Villemure and colleagues [14, c. 104] found that only odors that participants described as pleasant can improve mood, reduce anxiety and unpleasant pain, while unpleasant odors worsen mood and emotional effects of pain. And the results of a study by Campenni and colleagues showed that no matter what odor was present or not at all, the setting that the ambient odor "relaxes" reduces heart rate and skin conduction, and the setting that the ambient odor "stimulates", increases heart rate and skin conductivity [2, c. 1126]. These results show that the chemical nature of the odor itself plays a secondary role in the emotional and subjective changes that occur in the presence of the odor, and that the very meaning of the aroma causes the corresponding psychological and/or physiological reactions. Therefore, when studying the effect of essential oils should take into account both pharmacological and psychological hypotheses for a more accurate and extensive study of this subject.

Methodology. The study of the dynamics of the psychophysiological response and changes in cognitive processes as a result of the use of essential oils had two questions:

1) Do psychophysiological reactions of a person change in response to the stimulus in the form of the aroma of essential oils?

2) Does the use of essential oils affect the course of cognitive processes?

Particular attention was paid to the symptom complexes of sedative and stimulating effects of oils and the rate of these processes.

The study involved 50 people, of whom 25 men (50 %) and 25 women (50 %) aged 18 to 28 years. The average age of the sample was 24.5 years. To determine changes in cognitive processes, three methods were used – a test for the presence of cognitive impairment, a test for concentration and IQ-test of the Raven's progressive matrices test. A polygraph was used to record physiological changes in the body of the respondents, the choice of which is due to its ability to record a large number of physiological changes and fluctuations in the objective parameters of the activity of the human nervous system.

The study used the design of the classical experiment. Respondents were randomly divided into three groups: the first experimental, which received a mixture of oils with a stimulating effect, the second experimental – a mixture of oils with a sedative effect and the control group, whose members inhaled perfumed water. The subjects themselves were not informed about the claimed effect of the

fragrance that was presented to them. Polygram recording began with direct inhalation of the aroma and monitoring of physiological changes on the polygraph. After 2-3 minutes, a survey of subjective perception of aroma was conducted. After completing the first part of the experiment, the subject moved on to the second: testing the features of cognitive processes. Before the start of each test, the subject inhaled the aroma. The time during which the respondents completed the tasks was also recorded.

Results. Analysis of the polygram by descriptive-individual method revealed a number of psychophysiological changes in the body of the subjects. In the case of using a mixture of essential oils with a sedative effect, the respondents noticeably slow down breathing and reduce the skin-galvanic reaction, which gives grounds to talk about reducing stress and directing the resting state. This result is achieved in 3-4 minutes after the first presentation of the stimulus (aroma) (Fig. 1).

When using a mixture of essential oils with a stimulating effect after 2-2.5 minutes, the subjects' respiration accelerated, the skin galvanic reaction, tremor and jumps in the level of oxygen in the body increased (Fig. 2).

This reaction corresponds to the assumption of the sympathetic nervous system as a result of the use of stimulating essential oils. In the case of placebo (control group) no changes in the psychophysiological state were detected (Fig. 3).

The Kruskal-Wallis test for three groups was used to process the data obtained by testing. As a result, the following values were obtained: there are no differences between the groups in the time spent on the test for cognitive impairment, but there is a significant difference in the time spent on the test of attention and Raven's progressive matrices test. The group that received the stimulant oils spent more time taking the concentration test than the group with the sedative oil. Essential oils also had a significant effect on the mental activity of the respondents: the group with a mixture of sedative action passed through the Raven's progressive matrices test longer than the group with a mixture of stimulant action (Table 1).

An analysis of the subjective perception of aroma and its effect on changes in cognitive processes showed that respondents who were irritated by the smell spent more time solving Raven's progressive matrices test than those who liked the smell. The least time was spent by subjects in whom the aroma did not evoke feelings (Table 2).

Subsequent actions made it possible to determine that this time difference is caused by the qualitative composition of groups according to different subjective perceptions. The 50 % group that liked the fragrance consisted of respondents who received stimulant oils and another 50 % who received sedatives, so the result was averaged. The ones subjected to the influence of stimulative essential oils were the fastest to complete the test. The majority (75 %) of the subjects who were irritated by the smell inhaled perfumed water, and the rest – a mixture of oils that cause a sedative effect, which helped to obtain the longest period of time.

The specifics of the dynamics of psychophysiological reactions and changes in cognitive processes as a result of the use of essential oils have been studied. Based on the obtained data, it was found that essential oils have a significant effect on both psychophysiological responses and the course of human cognitive processes. Stimulating essential oils provoke stress, activation of the sympathetic nervous system and accelerate the passage of cognitive processes, in contrast to sedative oils, which cause calm and slow cognitive processes.

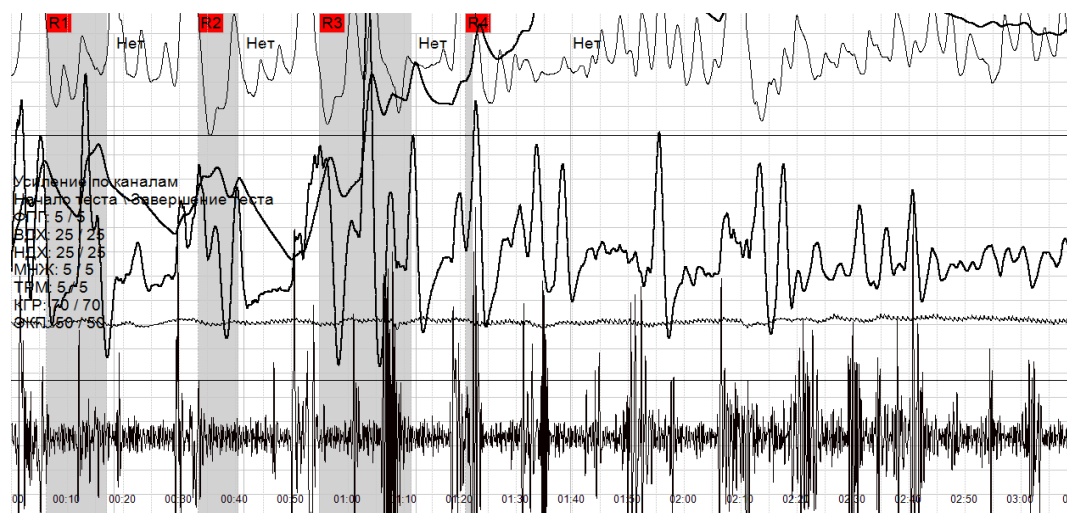


Fig. 1. Polygram of the subject who was exposed to a sedative mixture of essential oils

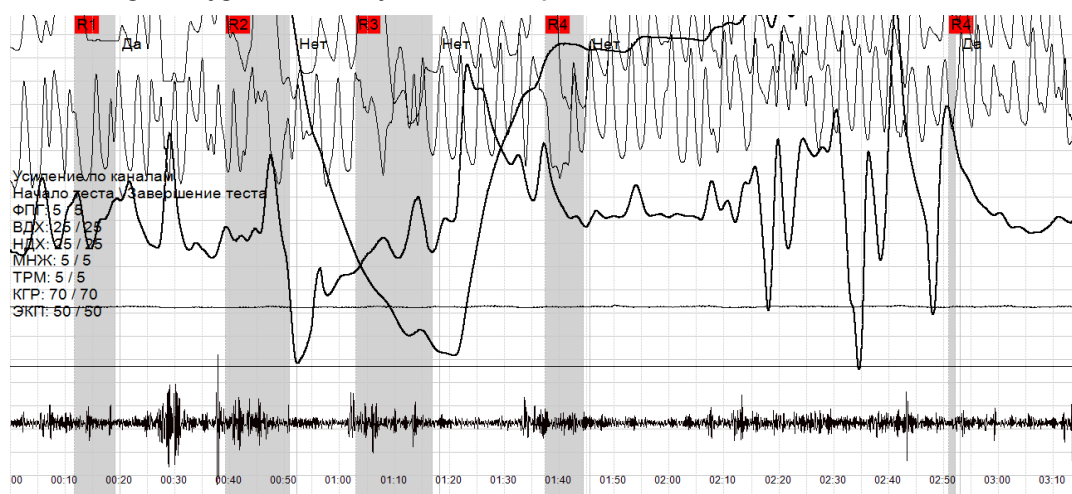


Fig. 2. Polygram of the subject who was exposed to a stimulating mixture of essential oils

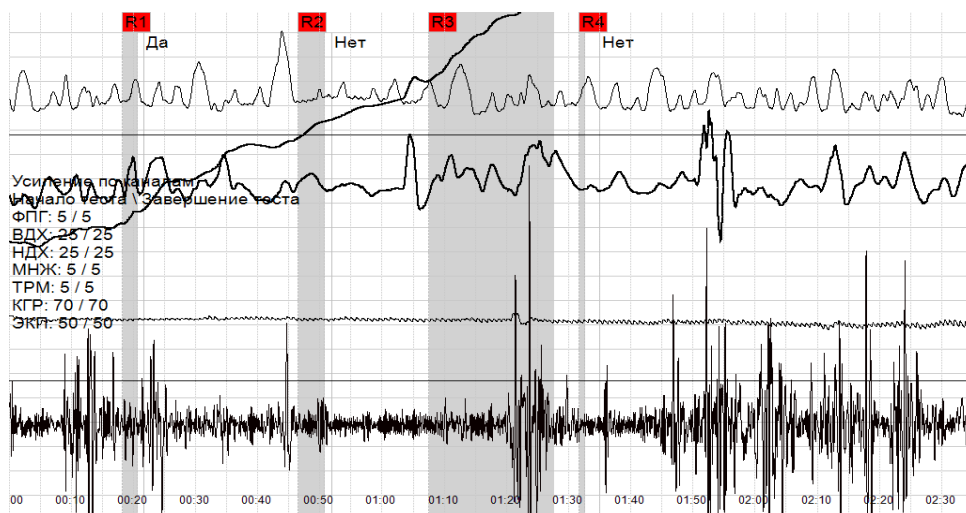


Fig. 3. Polygram of the subject from the control group

Table 1

Comparison of groups by time of concentration tests and Raven's progressive matrices test

	The action of oil	t (min)	The action of oil	t (min)	p (Kruskal-Wallis)
Concentration test	stimulating	1.71	sedatives	1.20	< .001
	stimulating	1.71	placebo	1.30	0.212
	sedatives	1.20	placebo	1.30	0.256
Raven's progressive matrices test	stimulating	16.3	sedatives	20.5	< .001
	stimulating	16.3	placebo	26.4	0.212
	sedatives	20.5	placebo	26.4	0.256

Table 2

Comparison of groups by subjective perception of aroma by the time of passage of Raven's progressive matrices test

	Subjective feelings	t (min)	Subjective feelings	t (min)	p (Kruskal-Wallis)
Raven's progressive matrices test	like	17.9	no sensations / I do not smell	14.0	0.002
	like	17.9	annoying	22.2	0.018
	no sensations / I do not smell	14.0	annoying	22.2	0.066

Discussion. The use of essential oils has a marked effect on changes in psychophysiological reactions and cognitive processes. Essential oils stimulation effect provokes increased breathing, increased dermal and galvanic reactions, accompanied by increased acidity in the body and increased tremor. This means that the sympathetic nervous system, which is responsible for the overall increase in activity of the body, is activated. The sedative effervescent oils slow down breathing and reduce the dermal and galvanic reaction, thus relieving the tension.

Cognitive processes are also altered by the use of essential oils. Stimulation oils reduce the concentration of attention compared to sedative oils. The latter, in turn, impair the thinking process, respondents needed more time to solve the tasks of the intellect test. Stimuli are used to help the process to continue. Therefore, the answers to the research questions were obtained.

The study of the effects of essential oils on the body and the sense of well-being of people opens up great possibilities in marketing and medicine. Thus, studying the effects of certain oils will help to indicate their specific effect and provide reliable information on their use in aromatherapy, the popularity of which in recent years is growing rapidly. The prospect of further research could be a repetition of our experiment, but with the involvement of more participants and a more in-depth analysis of the effects of essential oils on cognitive processes. As there are already enough studies on psychophysiological reactions, including this one, it is necessary to focus on the study of changes in the psychological state of people as a result of the use of oils, because there is a shortage in this aspect itself.

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СПЕЦИФІКА ПСИХОФІЗІОЛОГІЧНОЇ РЕАКЦІЇ ТА ЗМІН У КОГНІТИВНИХ ПРОЦЕСАХ ЯК РЕЗУЛЬТАТ ВИКОРИСТАННЯ ЕФІРНИХ ОЛІЙ

Представлено результати дослідження специфіки психофізіологічних реакцій та змін у когнітивних процесах унаслідок використання ефірних олій за допомогою класичного експерименту із застосуванням поліграфа. Проведено теоретичний аналіз наукових публікацій останніх років за зазначеною тематикою. Наукова новизна дослідження полягає у вивченні дії різних видів ефірних олій, визначеної їхнім комплексним впливом – активізацією чи заспокоєнням. Досліджено вплив стимуляційних і седативних ефірних олій на перебіг когнітивних процесів та зміни в організмі людини, а також вплив на ці характеристики суб'єктивного сприймання аромату. Виявлено значні розбіжності у швидкості когнітивних процесів залежно від виду ефірних олій та супутні виражені психофізіологічні реакції, зокрема активізацію нервової системи при вдиханні стимулюючих олій зі збільшенням швидкості мисленнєвих процесів і зниженням концентрації та протилежний ефект за дії седативних олій.

Ключові слова: ефірна олія, когнітивні процеси, психофізіологічні реакції, поліграф.