folia medica

Folia Medica 65(1):155-160
DOI: 10.3897/folmed.65.e71854

Original Article

Behavioral Effects of *Chaenomeles Maulei* Fruit Juice in Rats with Impaired Circadian Rhythm

Vesela Borisova-Nenova[1], Miroslav Eftimov[1], Stefka Valcheva-Kuzmanova[1]

[1] *Department of Pharmacology and Clinical Pharmacology and Therapeutics, Prof. Dr. Paraskev Stoyanov Medical University, Varna, Bulgaria*

Corresponding author: Stefka Valcheva-Kuzmanova, Department of Pharmacology and Clinical Pharmacology and Therapeutics, Prof. Dr. Paraskev Stoyanov Medical University, Varna, Bulgaria; Email: stefkavk@yahoo.com; Tel.: +359 52 677 078

Received: 20 July 2021 ♦ **Accepted:** 18 Aug 2021 ♦ **Published:** 28 Feb 2023

Citation: Borisova-Nenova V, Eftimov M, Valcheva-Kuzmanova S. Behavioral effects of *Chaenomeles maulei* fruit juice in rats with impaired circadian rhythm. Folia Med (Plovdiv) 2023;65(1):155-160. doi: 10.3897/folmed.65.e71854.

Abstract

Introduction: Impaired circadian rhythm (ICR) is a commonly used model of mild stress. The fruit juice of *Chaenomeles japonica var. maulei (Mast.) Lavall,e* (CMFJ) is rich in polyphenols known for their anti-inflammatory, antioxidant, and neuroprotective properties.

Aim: The aim of this study was to investigate the effects of CMFJ on the behavior of rats subjected to ICR.

Materials and methods: Male Wistar rats were divided into five groups of 10 animals each: control group (without ICR), the ICR, ICR+CMFJ$_{2.5}$, ICR+CMFJ$_5$, and ICR+CMFJ$_{10}$ groups. ICR was induced by exposing rats to 14 days of constant light. Over these days, oral treatment was administered with distilled water (the control and ICR groups) and CMFJ at doses 2.5, 5, and 10 ml/kg for the respective groups. Then we performed the open field test, the social interaction test (SIT), and the forced swim test (FST) to assess rats' locomotion, anxiety, and the depressive-like behavior, respectively.

Results: The ICR animals increased their horizontal and vertical locomotion when compared to the controls. The ICR rats did not change significantly the social interaction time in the SIT test and immobility time in the FST. The horizontal and vertical activity of the ICR+CMFJ$_{10}$ rats was reduced in comparison with ICR animals. Compared to ICR rats, the animals treated with CMFJ at doses of 2.5 and 10 ml/kg demonstrated an improved social interaction and decreased immobility time in the FST.

Conclusions: CMFJ prevented the development of ICR-induced hyperactivity and showed an anxiolytic-like and antidepressant-like effect, probably due to its high polyphenol content.

Keywords

anxiety, *Chaenomeles,* depression, mild stress, polyphenols

INTRODUCTION

The temporal pattern of animal behavior is regulated by the most significant environmental factor – the light. The environmental light controls the neuronal activity of the hypothalamic suprachiasmatic nucleus (SCN), which is involved in the regulation of the circadian rhythms of sleep[1], the body temperature[2], locomotion, and feeding.[3] The circadian rhythms persist with slightly altered period lengths ranging between 20 and 28 hours. Circadian rhythms are synchronized by the light-dark shifts and the length of the light-dark cycle within a day can affect the normal rhythmic patterns.[4]

Disruption of the circadian rhythms is a commonly used model of mild stress induced by frequent shifts or altered periods of the light-dark cycle, by long periods of constant light or by forced activity during the normal sleep phase.[5-7] Exposing rodents to such conditions can disrupt the circadi-

Copyright by authors. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

an rhythmicity and the normal sleep-wake pattern.[8] Artificial light for long intervals during the night promotes altered activity schedules, which can lead to conflicting signals to the biological clock.[9] Altered circadian rhythms lead to anxiety, depressive-like symptoms, anhedonia, and elevated plasma levels of corticosterone.[10] Constant light exposure is a useful model for studying learning/memory, anxiety-like behavior, and motor behavior of the same animals.

It has been proven that the circadian rhythm is involved in the regulation of the organisms' redox systems. There is a link between the redox state and the membrane excitability of the SCN neurons.[11] Alterations in the circadian rhythms can influence the generation and scavenging of free radicals.[12] Antioxidants can slow down the oxidation reactions and stimulate the production of endogenous antioxidants.[13] Naturally occurring compounds like polyphenols can affect diverse functions in the body, possibly due to their antioxidant properties.[14] Polyphenols can adjust or regulate also the circadian rhythm or modulate peripheral molecular clocks in rats.[15] There is evidence that (–)-epigallocatechin-3-gallate can associate with the circadian clock and ameliorate diet-induced metabolic syndrome.[16]

Chaenomeles japonica var. maulei (Mast.) Lavall,e is a polyphenol-rich plant belonging to the *Chaenomeles* genus. The plants from the *Chaenomeles* genus are widely used in the traditional Chinese medicine because of their anti-inflammatory, antioxidant, and neuroprotective properties. There is evidence that these effects may be attributed to the high concentrations of polyphenols such as flavonoids and phenolic acids in the fruits of the *Chaenomeles* species.[17]

The effects of the *Chaenomeles* plants on the behavior of experimental animals are poorly studied.

AIM

The aim of this study was to investigate the effects of the CMFJ on the behavior of rats subjected to impaired circadian rhythmicity (ICR) due to exposure to constant light.

MATERIALS AND METHODS

Experimental substances

Chaenomeles maulei fruit juice was produced from plants grown in the Balkan Mountains, Bulgaria, in the region of Troyan. The freshly handpicked fruits were grinded, crushed, and squeezed. The juice was filtered, preserved with potassium sorbate (1.0 g/l), and stored at 0°C until experiments. The total content of phenolic compounds in CMFJ proved to be very high - 8900.00 mg gallic acid equivalents per liter of juice. It was determined by spectrophotometric Folin-Ciocalteu assay.[18] Absorbance was read at 760 nm. Gallic acid was used as a standard. The HPLC analysis confirmed the high content of polyphenols, especially phenolic acids and flavonoids. The phenolic acids were presented in the highest concentration by vanillic acid (149.1 mg/l), caffeic acid (144.8 mg/l), and chlorogenic acid (110.0 mg/l).[19] The most abundant flavonoids in the fruit juice were epicatechin (5.59 mg/l), catechin (52.5 mg/l), and (quercetin 35.8 mg/l).[19]

Animals

We used healthy male Wistar rats with mean weight of 220±30 g, bred in the Animal Centre of Medical University of Varna. The animals were housed in plastic cages in a well-ventilated room maintained at 22±1°C and on a 12/12 light/dark cycle. They received standard rodent pelleted diet and water ad libitum. All procedures concerning animal treatment and experimentation were conducted in conformity with the national and international laws and policies (EU Directive 2010/63/ EU for animal experiments) and were approved by Bulgarian Food Safety Agency (No. 141/23.06.2016).

Experimental design

In this study, 50 male Wistar rats were divided into five groups, each consisting of 10 animals. The groups were respectively the control, ICR, ICR+$CMFJ_{2.5}$, ICR+$CMFJ_5$, and ICR+$CMFJ_{10}$.

Treatment of the animals was carried out as follows: the animals from the control and ICR groups were treated once daily with distilled water (10 ml/kg) through an orogastric cannula. The animals from the ICR+$CMFJ_{2.5}$ group received once daily 2.5 ml/kg of CMFJ diluted with distilled water to 10 ml/kg. The animals from the ICR+$CMFJ_5$ group were treated once daily with CMFJ at a dose of 5 ml/kg, diluted to 10 ml/kg with distilled water. The animals from the ICR+$CMFJ_{10}$ group received CMFJ at a dose of 10 ml/kg once a day.

The administration period was 14 days during which the animals from groups ICR, ICR+$CMFJ_{2.5}$, ICR+$CMFJ_5$ and ICR+$CMFJ_{10}$ were subjected to impaired circadian rhythmicity (ICR) through exposure to continuous light. The control animals had a normal lighting regime throughout the duration of the experiment. Fifteen days after the experiment started, one hour after the oral treatment, the open field test was performed. At 16 days, 1 hour after the oral treatment, the social interaction test was conducted. On the next two days, 1 hour after the oral treatment, a training and experimental session of the forced swim test were carried out.

Open field test (OFT)

The OFT is one of the experimental paradigms initially introduced to estimate the locomotor activity and willingness of animals to explore.[20] The test allows measuring the behavior of an animal after it is released into an open, novel arena.[21] The open field was a wooden arena

(100×100×40 cm) painted white. The floor was divided with blue paint into 25 equal-size squares. The duration of the test session for each animal was 5 min. The measure for the horizontal activity was the number of squares crossed with four paws (crossings). The vertical activity was measured by the times the animal stood on its hind limbs (rearings).

Social interaction test (SIT)

The test consists in placing unfamiliar pairs of animals under conditions of bright light and unfamiliar arena, according to the method described by File and Hyde.[22] The square arena of the open field apparatus (100×100×40 cm) was used. The partner animals were matched by weight (difference of no more than 10 g was allowed). The two rats were gently placed at two opposite corners of the arena. The duration of the test period was 5 minutes during which the following behaviors were recorded: sniffing, nipping, grooming, following, mounting, kicking, jumping on, and crawling over or under the partner (active interaction). Passive interactions like lying or sitting next to each other was not considered a sign of social contact. The prolonged involvement in active interactions indicated reduced anxiety.

Forced swim test (FST)

The forced swim test, also known as the Porsolt test, was carried out in two sessions in two consecutive days.[23] The training session took place 24 hours after the SIT and the test session took place exactly 24 hours after the training session. Because of its relative simplicity, the FST has become a widely used procedure in the screening of antidepressant drugs. FST measures coping behavior to an inescapable stress and allows the assessment of 'behavioral responses'.[24] According to the protocol, the animals were tested one by one in a transparent glass cylinder (17 cm in diameter and 60 cm in height). The cylinder was filled partially with water (22±1°C), so that there was some space left, but not allowing the animals to escape. Each animal was dropped down in water and its activity was documented for 5 min. The immobility time, which was the time during which the animal assumed an immobility posture with only minimal movements necessary to keep his head above the water, during the test session was recorded. The longer duration of the immobility time is related to increased behavioral despair while anti-depressant drugs decrease the immobility time.[25]

Statistical analysis

The results obtained were expressed as mean ± SEM. The data were analyzed by one-way ANOVA, followed by Dunnett's multiple comparison post hoc test. A level of $p<0.05$ was considered significant. All analyses were performed using GraphPad Prism statistical software.

RESULTS

Open field test

The results from the OFT are presented in **Fig. 1**. The animals in the ICR group showed a statistically significant increase ($p<0.05$) in the locomotion (crossings 63.4±6.8, rearings 22.4±2.3) in comparison with the control group (crossings 39.7±6.25, rearings 12.9±1.9). The number of crossings and rearings of the ICR+CMFJ$_{2.5}$ and ICR+CMFJ$_5$ animals did not show a significant difference when compared to the controls or the ICR group. The crossings (29.8±5.2) and rearings (14.3± 2.2) of ICR+CMFJ$_{10}$ animals were significantly decreased ($p<0.05$) in comparison with the ICR results.

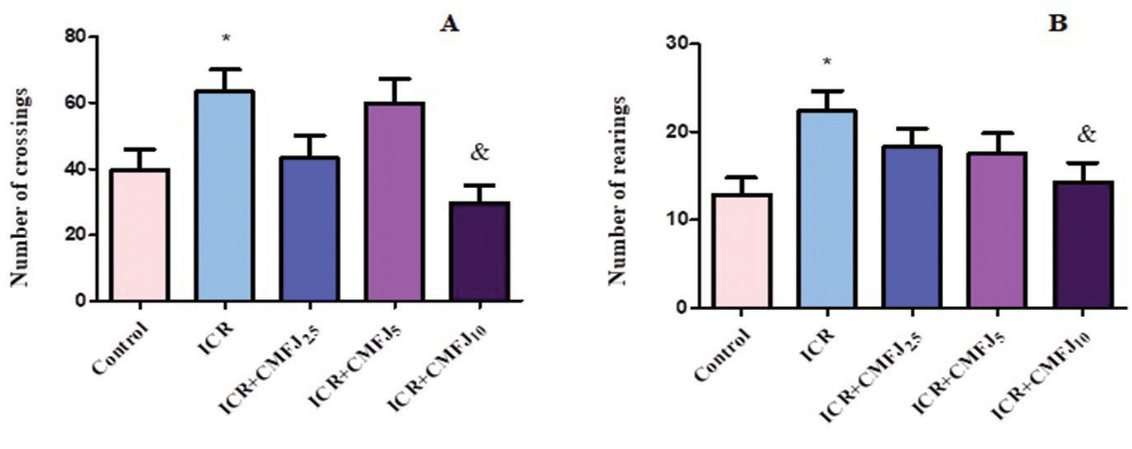

Figure 1. Effect of *Chaenomeles maulei* fruit juice (CMFJ) administration at doses of 2.5, 5, and 10 ml/kg on the number of crossings (panel **A**) and rearings (panel **B**) in the open field test in rats subjected to impaired circadian rhythm (ICR); *$p<0.05$ vs. control; $^{\&}p<0.05$ vs. ICR.

Social interaction test

The social interaction time of ICR rats (31.8±4.0 sec) was slightly decreased compared to that of the control group (36.8±10.3 sec). Administration of $CMFJ_{2.5}$ produced an increase in the time spent in social interaction (52.98±2.14) when compared to the ICR group (p<0.01). The animals from the ICR+$CMFJ_{10}$ group also showed a significant increase (p<0.05) in the social interaction time (51.6±6.84) in comparison with the ICR animals. The social interaction time of the animals belonging to ICR+CMFJ5 group was not significantly different from that of the control and ICR rats **(Fig. 2)**.

Forced swim test

The immobility time of the ICR animals (115.6±11.4 sec) was slightly but not significantly increased when compared with the control (105.8±15.1 sec). The administration of CMFJ at doses of 2.5 and 10 ml/kg produced a significant reduction of the immobility time in comparison with the ICR group. The results obtained were 84.9±7.7 sec for the ICR+$CMFJ_{2.5}$ group (p<0.01 vs. ICR) and 73.8±11.7 SEC for the ICR+$CMFJ_{10}$ group, respectively (p<0.05). The administration of CMFJ at the dose of 5 ml/kg resulted in an immobility time of 100.3±18.9 sec which was not significantly different from that of the control and ICR rats **(Fig. 3)**.

DISCUSSION

Literature data show that the short-term exposure of animals to impaired circadian rhythmicity for up to 2 weeks could significantly increase the levels of corticosterone and could activate the monoamine system.[26] The elevated levels of monoamines and corticosterone are associated with behavioral stress and motor hyperactivity.[27] In this experiment, we can explain the increased motor activity of the ICR group in the open field test with the increased levels of monoamines and the activation of the HPA axis. Administration of CMFJ antagonized the increased motor activity of ICR rats.

The social interaction test mimics natural interactions by allowing the free contact between the rats. A decreased interaction between the animals indicates social avoidance, which reflects a stress-induced anxiety.[28] The chronic mild stress has been known to increase the social avoidance in male rats resulting in a decreased social interaction.[29] In the present experiment, the disturbed light-dark cycle reduced the time spent in social interactions, although this effect was not statistically significant. The social interaction time was increased by administration of CMFJ at doses of 2.5 and 10 ml/kg. These results demonstrated the anxiolytic-like effect of the treatment. This effect might be due to the polyphenols found in CMFJ exerting an anxiolytic effect probably by decreasing the HPA activity, the oxidative stress levels or by activation of the dopaminergic system in the frontal cortex, as demonstrated for other polyphenols.[30]

Apart from anxiety, the constant light exposure leads to depressive-like behavior in animals.[31] In the forced swim test, the immobility time was slightly elevated, though falling short of statistical significance, for the ICR group when compared to the control animals. The administration of CMFJ at doses of 2.5 ml/kg and 10 ml/kg reduced significantly the immobility time of ICR rats. CMFJ at a dose of 2.5 ml/kg had the most pronounced effect on the immobility time when compared to the ICR group. In the open field test, the doses of 2.5 ml/kg and 10 ml/kg were associated with the most evident decrease in the motor activity. So, the decrease of the immobility time could not be attributed to a decreased motor activity. Thus, the combination of results of the both tests suggested that CMFJ at the doses of 2.5 and 10 ml/kg exerted an antidepressant-like effect in the

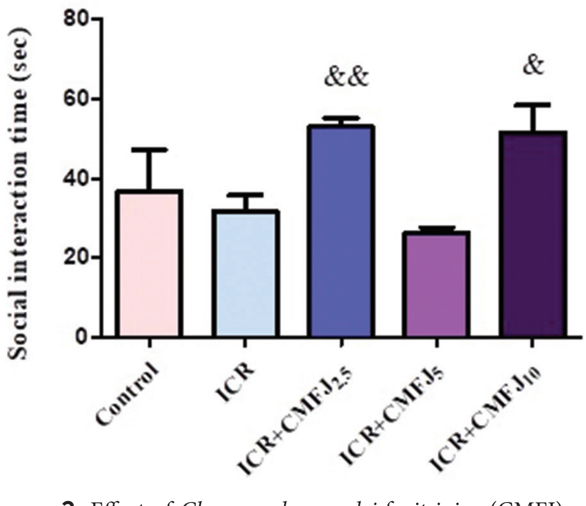

Figure 2. Effect of *Chaenomeles maulei* fruit juice (CMFJ) administration at doses of 2.5, 5, and 10 ml/kg on the social interaction time in rats subjected to impaired circadian rhythm (ICR); &p<0.05 vs. ICR, &&p<0.01 vs. ICR.

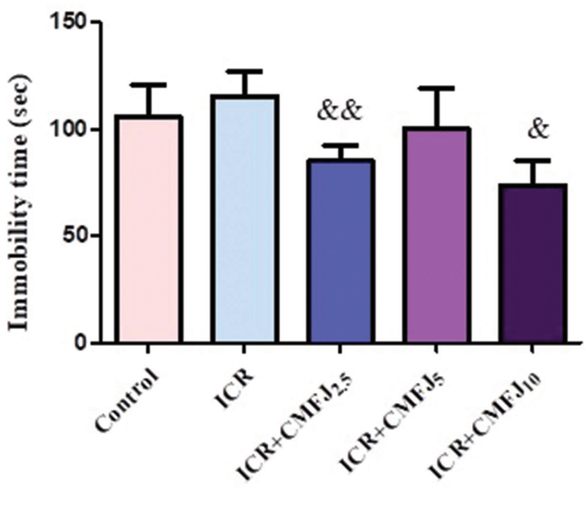

Figure 3. Effect of *Chaenomeles maulei* fruit juice (CMFJ) administration at doses of 2.5, 5, and 10 ml/kg on the immobility time in the forced swim test in rats subjected to impaired circadian rhythm (ICR); &p<0.05 vs. ICR, &&p<0.01 vs. ICR.

presence of mild stress.

The full development of depressive-like behavior requires exposure to chronic stress lasting at least 4 weeks. During this time, the typical biochemical and behavioral indicators of depressive behavior can develop in the animals. Since the exposure of animals to impaired 24-hour light rhythm did not produce a depressive-like behavior, we assumed that the 14-day presence of constant light was not enough for the full development of depression. Nevertheless, the administration of CMFJ showed a potential to protect against stress-induced behavioral changes. The reduced immobility time in the forced swim test can be explained by the biological activity of the polyphenols found in CMFJ. For example, the flavonoid quercetin reduced the motor activity and the immobility time in a model of chronic mild stress in rats. The administration of quercetin restored the levels of oxidative stress, the MAO activity, and the levels of serotonin in the CNS. These mechanisms of action might explain the observed effects in the behavioral tests in animals.[32]

CONCLUSIONS

Administration of *Chaenomeles maulei* fruit juice could ameliorate anxiety-like and depression-like behavior of animals subjected to impaired circadian rhythm. These effects of the juice might be attributed to the biological activity of its polyphenolic ingredients.

Acknowledgements

The authors have no support to report.

Funding

The authors have no funding to report.

Competing Interests

The authors have declared that no competing interests exist.

REFERENCES

1. Eastman C, Mistlberger R, Rechtschaffen A. Suprachiasmatic nuclei lesions eliminate circadian temperature and sleep rhythms in the rat. Physiol Behav 1984; 32:357–68.
2. Ruby N, Ibuka N, Barnes B, et al. Suprachiasmatic nuclei influence torpor and circadian temperature rhythms in hamsters. Am J Physiol 1989; 257:R210–5.
3. Stephan F, Zucker I. Circadian rhythms in drinking behavior and locomotor activity of rats are eliminated by hypothalamic lesions. Proc Natl Acad Sci USA 1972; 69:1583–6.
4. Franken P, Tobler I, Borbely A. Varying photoperiod in the laboratory rat: profound effect on 24-h sleep pattern but no effect on sleep homeostasis. Am J Physiol 1995; 38:R691–701.
5. Saldago-Delgado R, Angeles-Castellanos M, Buijs M, et al. Internal desynchronization in a model of night-work by forced activity in rats. Neurosci 2008; 154(3):922–31.
6. Einat H, Kronfeld-Schor N, Eilam D. Sand rats see the light: short photoperiod induces a depression-like response in a diurnal rodent. Behav Brain Res 2006; 173(1):153–7.
7. Ikeda M, Sagara M, Inoue S. Continuous exposure to dim illumination uncouples temporal patterns of sleep, body temperature, locomotion and drinking behavior in the rat. Neurosci Letters 2000; 279(3):185–9.
8. De la Iglesia H, Cambras T, Schwartz W, et al. Forced desynchronization of dual circadian oscillators within the rat suprachiasmatic nucleus. Curr Biol 2004; 14(9):796–800.
9. Navara K, Nelson R. The dark side of light at night: physiological, epidemiological, and ecological consequences. J Pineal Res 2007; 43(3):215–24.
10. Predergast B, Kay L. Affective and adrenocorticotrophic responses to photoperiod in Wistar rats. J Neuroendo 2008; 20(2):261–7.
11. Wang T, Yu Y, Govindaiah G, et al. Circadian rhythm of redox state regulates excitability in suprachiasmatic nucleus neurons. Science 2012; 337:839–42.
12. Fanjul-Moles M. ROS signaling pathways and biological rhythms: perspectives in crustaceans. Front Biosci 2013; 18(2):665–75.
13. Zhang H, Zhang Y. Melatonin: a well-documented antioxidant with conditional pro-oxidant actions. J Pineal Res 2014; 57(2):131–46.
14. Ribas-Latre A, Baselga-Escudero L, Casanova E, et al. Chronic consumption of dietary proanthocyanidins modulates peripheral clocks in healthy and obese rats. J Nutr Biochem 2015; 26:112–9.
15. Oike H, Kobori M. Resveratrol regulates circadian clock genes in Rat-1 fibroblast cells. Biotechnol Biochem 2008; 72:3038–40.
16. Mi Y, Qi G, Fan R, et al. EGCG ameliorates diet-induced metabolic syndrome associating with the circadian clock. Biochim Biophys Acta Mol Basis Dis 2017; 1863(6):1575–89.
17. Du H, Wu J, Li H, et al. Polyphenols and triterpenes from Chaenomeles fruits: Chemical analysis and antioxidant activities assessment. Food Chem 2013; 141:4260–8.
18. Singleton V, Rossi J. Colorimetry of total phenolics with phosphomolybdic-phosphotungic acid reagents. Am J Enol Vitic 1965; 16:144–58.
19. Valcheva-Kuzmanova S, Denev P, Ognyanov M. Chemical composition and antioxidant activity of Chaenomeles maulei fruit juice. J Biomed Clin Res 2018; 11(1):41–8.
20. Perals D, Griffin A, Batomeus I, et al. Revisiting the open-field test: what does it really tell us about animal personality? Anim Behav 2017; 123:69–79.
21. Carola V, D'Olimpio F, Brunamonti E, et al. Evaluation of the elevated plus-maze and open-field tests for the assessment of anxiety-related behaviour in inbred mice. Behav Brain Res 2002; 134:49–57.
22. File S, Hyde J. Can social interaction be used to measure anxiety? Br J Pharmacol 1978; 62:19–24.
23. Castagné V, Moser P, Roux S, et al. Rodent models of depression: forced swim and tail suspension behavioral despair tests in rats and mice. Curr Protoc Pharmacol 2010; 49(1):5–8.
24. Commons K, Cholanians A, Babb J, et al. The rodent forced swim test measures stress-coping strategy, not depression-like behavior. ACS Chem Neurosci 2017; 8:955–60.
25. Yankelevitch-Yahav R, Franko M, Huly A, et al. The forced swim test as a model of depressive-like behavior. J Vis Exp 2015; 97:525–87.
26. Van der Meer E, Van Loo P, Baumans V. Short-term effects of a dis-

turbed light-dark cycle and environmental enrichment on aggression and stress-related parameters in male mice. Lab Anim 2004; 38(4):376–83.
27. Belda X, Fuentes S, Daviu N, et al. Stress-induced sensitization: the hypothalamic-pituitary-adrenal axis and beyond. Stress 2015; 18(3):269–79.
28. Toth I, Neumann I. Animal models of social avoidance and social fear. Cell Tissue Res 2013; 354(1):108–18.
29. Venzala E, García-García A, Elizalde N, et al. Social vs. environmental stress models of depression from a behavioural and neurochemical approach. Eur Neuropsychopharmacol 2013; 23(7):697–708.
30. Kita M, Uchida S, Yamada K, et al. Anxiolytic effects of theaflavins via dopaminergic activation in the frontal cortex. Biosci Biotechnol Biochem 2019; 83(6):1157–62.
31. Fonken L, Finy M, Walton J, et al. Influence of light at night on murine anxiety- and depressive-like responses. Behav Brain Res 2009; 205(2):349–54.
32. Singh V, Chauhan G, Shri R. Anti-depressant like effects of quercetin 4'-o-glucoside from allium cepa via regulation of brain oxidative stress and monoamine levels in mice subjected to unpredictable chronic mild stress. Nutr Neurosci 2021; 24(1):35–44.

Поведенческие эффекты фруктового сока *Chaenomeles Maulei* у крыс с нарушением циркадного ритма

Весела Борисова-Ненова[1], Мирослав Ефтимов[1], Стефка Валчева-Кузманова[1]

[1] *Кафедра фармакологии и клинической фармакологии и терапии, Медицинский университет „Проф. д-р Параскев Стоянов“, Варна, Болгария*

Адрес для корреспонденции: Стефка Валчева-Кузманова, Кафедра фармакологии и клинической фармакологии и терапии, Медицинский университет „Проф. д-р Параскев Стоянов“, Варна, Болгария; Email: stefkavk@yahoo.com; тел.: +359 52 677 078

Дата получения: 20 июля 2021 ♦ **Дата приемки:** 18 августа 2021 ♦ **Дата публикации:** 28 февраля 2023

Образец цитирования: Borisova-Nenova V, Eftimov M, Valcheva-Kuzmanova S. Behavioral effects of *Chaenomeles maulei* fruit juice in rats with impaired circadian rhythm. Folia Med (Plovdiv) 2023;65(1):155-160. doi: 10.3897/folmed.65.e71854.

Резюме

Введение: Нарушение циркадного ритма (ICR) является широко используемой моделью лёгкого стресса. Сок плодов *Chaenomeles japonica var. maulei (Mast.) Lavalle* (CMFJ) богат полифенолами, известными своими противовоспалительными, антиоксидантными и нейропротекторными свойствами.

Цель: Целью данного исследования было изучение влияния CMFJ на поведение крыс, подвергнутых ICR.

Материалы и методы: Самцов крыс линии Вистар разделили на пять групп по 10 животных в каждой: контрольная группа (без ICR), группы ICR, ICR+CMFJ2.5, ICR+CMFJ5 и ICR+CMFJ10. ICR индуцировали, подвергая крыс воздействию постоянного света в течение 14 дней. В эти дни перорально применяли дистиллированную воду (контрольная и ICR -группы) и CMFJ в дозах 2.5, 5 и 10 ml/ kg для соответствующих групп. Затем мы провели тест «открытое поле», тест социального взаимодействия (SIT) и тест принудительного плавания (FST) для оценки локомоции, тревожности и депрессивного поведения крыс соответственно.

Результаты: Животные группы ICR увеличили свою горизонтальную и вертикальную локомоцию по сравнению с контрольной группой. Крысы ICR существенно не изменили время социального взаимодействия в тесте SIT и время неподвижности в тесте FST. Горизонтальная и вертикальная активность крыс ICR+CMFJ10 была снижена по сравнению с животными ICR. По сравнению с крысами ICR у животных, получавших CMFJ в дозах 2.5 и 10 ml/ kg, наблюдалось улучшение социального взаимодействия и уменьшение времени неподвижности в FST.

Заключение: CMFJ предотвращал развитие индуцированной ICR гиперактивности и проявлял анксиолитический и антидепрессантный эффект, вероятно, из-за высокого содержания полифенолов.

Ключевые слова

тревога, *Chaenomeles*, депрессия, лёгкий стресс, полифенолы