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THE EFFECT OF CAFETERIA DIET AND SOCIAL ISOLATION ON SOME BIOCHEMICAL, PHYSIOLOGIGAL AND BEHAVIOR PARAMETERS IN MICE

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Recent studies have shown the intricate interplay between social isolation and weight regulation [1]. In particular, it has been revealed that mice subjected to prolonged social isolation often display alterations in their eating patterns, consuming more food and exhibiting a preference for high-calorie, palatable foods [2]. Moreover, the isolated mice tended to be less active, engaging in reduced physical activity compared to their socially connected counterparts. These behavioral changes can disrupt the delicate balance between energy intake and expenditure, ultimately contributing to weight gain and obesity. In addition, isolated mice may experience dysregulation in leptin and ghrelin involved in appetite control and energy balance [3, 4].

Loneliness and social isolation have been linked to increased levels of chronic emotional stress, which triggers the release of stress hormones like cortisol, which not only stimulate appetite but also promote the accumulation of abdominal fat, increasing the risk of obesity-related complications such as type 2 diabetes and cardiovascular disease [5, 6].

Aim. The purpose of our work was to test the effect of cafeteria diet and social isolation on physiological and biochemical indicators of mice.

Materials and Methods. Female C57BL/6J mice aged 3 months were randomly sorted into four groups: co-housed control, co-housed cafeteria diet (CD), individually housed control (SI), and individually housed CD (CD SI). The CD comprised chocolate, nuts, crackers, and standard food (2:1 ratio) for 12 weeks. Body mass, food/water intake were monitored. Open field test assessed behavior using ToxTrack software. Blood glucose levels used LipidoCare lipidometer and glucose oxidase strip test. Myeloperoxidase activity measured spectrophotometrically in plasma. Paraoxonase activity evaluated using Tris-HCl, $CaCl_2$, and supernatant mixture at 405 nm. GraphPad Prism 10 analyzed data via one-way ANOVA, Welch's t-test with Benjamini-Hochberg correction. Results presented as mean ± SEM, with $P \leq 0.05$ indicating significance between groups.

Results and Discussion. Throughout the experiment, we monitored body mass of mice fed different diets and housed in groups or individually. As we can see in Fig. 1, mice that consumed the cafeteria diet in a group or individually gained body mass more rapidly than mice that fed a standard food. At the same time, mice kept individually gained body mass more intensively than their group counterparts (Fig. 1). During the experiment, we monitored also food consumption and water drinking. Fig. 2, *A*–*B* represent average consumption of food and water by mice in different groups. Grouped mice fed CD consumed more food than those fed a standard food (Fig. 2, *A*). Social isolation led to increase in food intake in both feeding groups, on the standard diet and CD.

The cafeteria diet had no impact on group water intake in mice (Fig. 2, *B*). Socially isolated mice on a standard diet consumed more water than group-fed control mice. However, socially isolated mice on a cafeteria diet drank less water compared to those on a standard diet. Blood glucose levels were higher in all experimental groups compared to group-fed control mice on a standard diet (Fig. 3, *C*), indicating that both cafeteria diet and social isolation led to elevated blood glucose levels. This suggests increased food consumption in these mice.

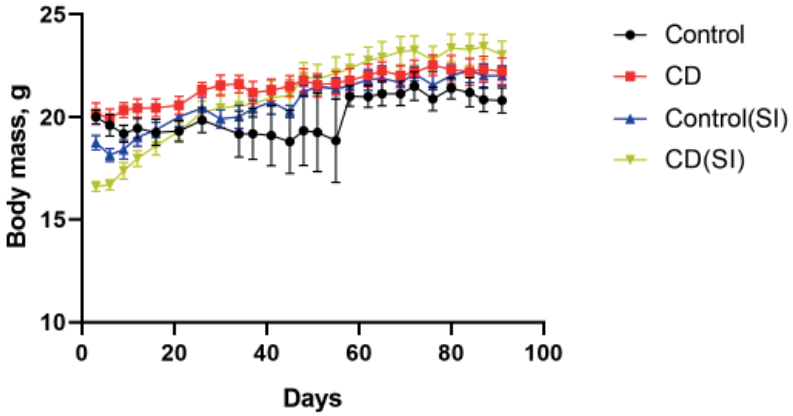

Fig. 1. **Dynamics of body mass of mice fed the standard food and housed in the group (control group) or individually (control (SI) group) and mice fed the cafeteria diet and housed in the group (CD group) or individually (CD (SI) group) for 12 weeks**
$n = 4–5$

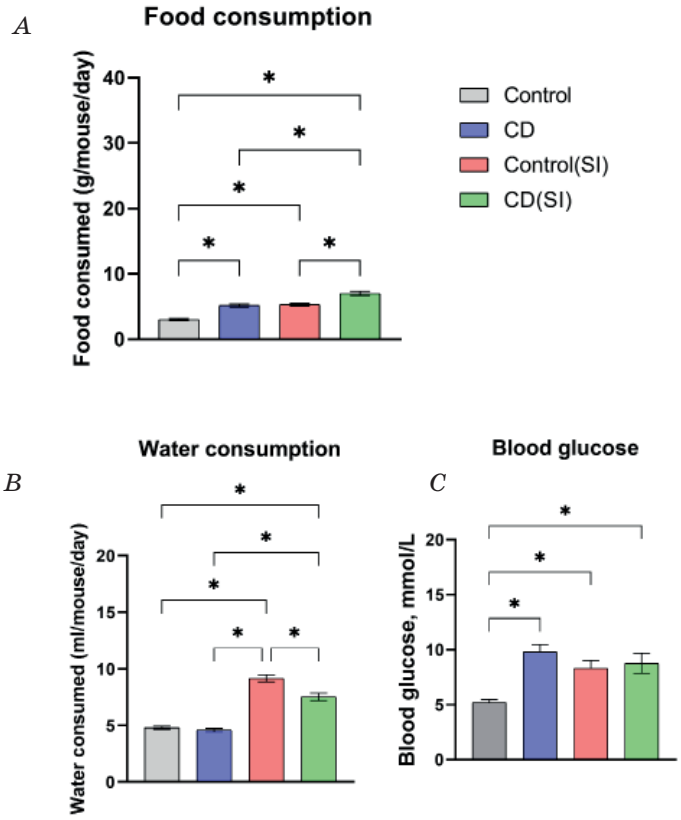

Fig. 2. **Average food consumption (*A*), average water consumption (*B*), and fasting blood glucose level at the end of the experiment (*C*) in mice**
$n = 4–5$. Another information is as in Fig. 1

Next, we also determined whether cafeteria diet and social isolation separately and in combination affected mouse behavior. To test behavior, we used a standard open field test by measuring such behavioral parameters as average speed, total distance, and time spent in inner and outer zone. Then we determined activity of some biochemicals parameters such as protein level, activity of paraoxonase and myeloperoxidase.

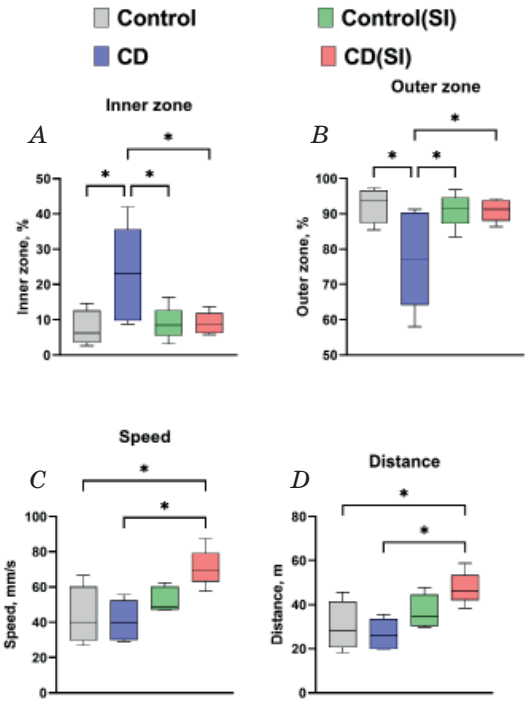

Fig. 3. **Time spent in inner zone (*A*), time spent in outer zone (*B*), average speed (*C*), and total distance (*D*) in the open field test (total duration — 10 min)**
n = 4–5

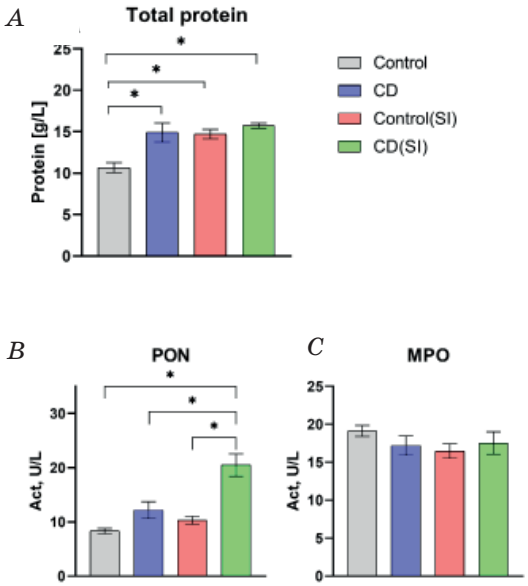

Fig. 4. **Content of protein (*A*), activity of paraoxonase (*B*), myeloperoxidase (*C*)**
n = 4–5

Grouped mice fed cafeteria diet spent more time in inner zone, than mice in other experimental groups (Fig. 3, *A*, *B*). Social isolation in the combination with the standard food did not affect the tested behavior parameters in mice compared with the control mice kept in the group (Fig. 3, *A*–*D*). Social isolation in the combination with the cafeteria diet increased locomotor activity of mice compared to other mouse groups, that indicates the development depression-like behavior in mice kept individually on cafeteria diet.

Additionally, we quantified the protein content and assessed the activities of paraoxonase and myeloperoxidase to glean insights into oxidative stress levels, antioxidant capacity, and

inflammatory status. As depicted in Fig. 4, *A*, discernible disparities were observed between the control group and all other experimental groups, suggestive of potential metabolic dysregulation. Moreover, in Fig. 4, *B*, a notable distinction was evident between the CD(SI) group and the remaining groups, indicative of heightened stress levels in the mice within this group.

Conclusions. Social isolation combined with a standard diet in group-housed mice causes physiological changes similar to those induced by a cafeteria diet, including weight gain, increased food intake, and elevated blood glucose levels. However, only the cafeteria diet, not social isolation, lowers research activity. The combination of social isolation and cafeteria food exacerbates some changes, leading to greater weight gain, food consumption, and depressive behavior. Biochemical analyses revealed differences in oxidative stress, antioxidant capacity, and inflammatory status among experimental groups, with cafeteria diet and socially isolated mice showing distinct patterns indicative of metabolic dysregulation and heightened stress levels compared to control groups.

Key words: stress, behavior, mice, social isolation, obesity, fasting glucose, enzyme activity.

Authors' Contribution: V.P. Derkachov — investigation, data analysis and writing, M.M. Bayliak — supervision, conceptualization, review and editing.

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