Workability, endurance and energy shifts in consolidation and memory in aggressive and non-aggressive animals and and Neurochemical profile

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Abstract*—Aggression is a motivational behaviour which has a definite direction. On the other hand, we can consider it as a reason of social degradation or it can be viewed as a population and civilization suppressor. Insensive researches are being carried out in resent years in order to define the characteristic mechanisms of aggression, for example, to determine the emotional condition of the subject. Emotions are specific objective changes typical for viability which are identified through biochemical, electrophysiological, motor functions (2,4,9). This is why the objective of our work is to determine endurance and workability in aggressive and non-aggressive animals.*

Keywords— Aggressive and non-aggressive rats, neurochemical profile, exercise performance, endurance, biogenic amines.

I. MATERIALS AND METHODS

The determination of physical workability and endurance in rats was performed by a well-known method. Animals *perform* physical load on the rotarod (5). The rotarod is a device with 5 running rods which move at a definite speed. The speed gradually increses and reaches 45 r/min. In case of fatigue the animal falls down where the magnet sensors are installed and which trace the falling down. After the falling of the all five rats one can see on the screen the distance and the time spent by the animals on each running rod before the falling. The passive avoidance is studied by Buresh method. After learning in 24 hours we placed the rat aging in the light cell, opened the doors connecting doors and during 3 minutes we were registering the amount of movement between cells and the time spent in the small cell. The absence of movement into the dark cell suggested about good reproduction of the animal (1-2,6,7).

II. MATERIALS AND RESULTS

As it is known from literature aggressive animals are characterised by high workability, different physiological parameters (6,8). As a result of comparison of more aggressive and less aggressive animals it was determined that the more aggressive animals are distinguished by higher workability and endurance compared to the non-aggressive ones. As it is known from literature (7), there the activation of glucose transport through GLUT4 translocation occures, by means of which glucose shifts from intracellular vesicles to the surface of the cell and after which the synthesis of glucose metabolism occurs (9). In other words, the activation of energy shift happens. As the insulin stimulation, the activation of glucose transport and respectively the synthesis of glucose are going fast it is possible that such energy induces endurance and workability. As one can see in pic.1 the workability of less aggressive animals is lower compared to more aggressive animals and the endurance of the both is higher compared to non-aggressive animals (3). Since non-aggressive animals stay on the rod less time and run through less distance, we can conclude that aggressive aminals, either more aggressive or less aggressive ones, show higher workability, but if we compare more aggressive and less aggressive animals to each other it is obvious that more aggressive ones have higher workability and endurance. This is, of course, connected to definite stress and thus, glucose shift to surface of a cell and after which the synthesis of glucose metabolism occurs, and this causes workability increase and quick assimilation to the given environment and their moving to a safer place, what is less expressed in less aggressive animals and even less in non-aggressive animals. Thus, we can conclude that in the animals which have not formed their hierarchical status yet and are only 60 days old and weigh 75 grams (immature offsprins), in other words, already in offspring, until the social hierarchy is formed, the difference between both aggressive animals from non-

aggressive ones by their workability and endurance is clearly noticeable. Intensified energy change causes increase of workability what is exposed by the long-term stay on the treadmill rod of both aggressive and relatively more aggressive aminals (pic. 1).

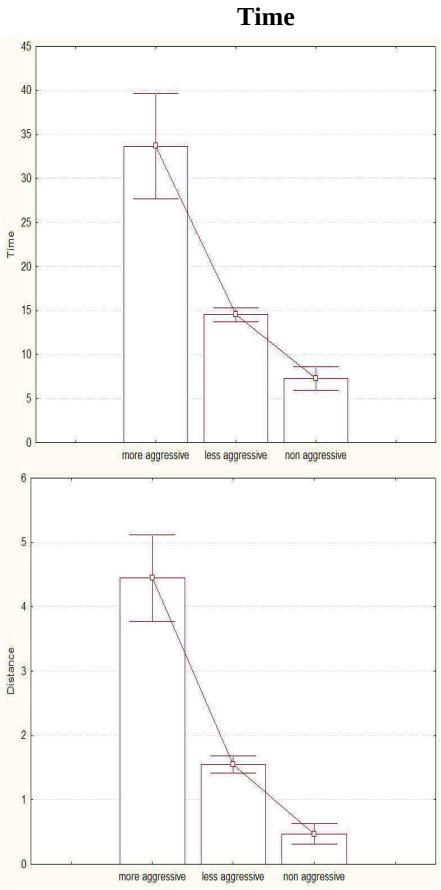


Fig.1: The movement of more aggressive and less aggressive rats on the treadmill

The following test on studying memory of aggressive and non aggressive animals were carried out in order to determine how those energy shifts reflected on memory of aggressive and non aggressive animals.

III. RESULT AND THEIR DISCUSSION

According to the figure2, the rates that are distinctive with less aggressiveness entered in a dark cell (99,16±9,00) than more aggressive ones (75,72±1,95). Consequently the difference between them is 1.3, which is statistically reliable. Even at browsing the amount of boluses and urination in a dark cell is more (5,91±0,79) than at removing the more aggressive arts (3,00±0,63). The difference is 1.97 and is statistically reliable P<0.05. less aggressive leave the dark cell relatively later after (99,16±9,0) secs and move into a light cell and stay there for (70,08±3,6) secs. While more aggressive leave the dark cell relatively soon 75,72±1,9) and move into the light cell an stay there (90,09±5,9). The difference is 1.28 fold, that is statistically reliable P<0.05 Regarding the putting out the head the less aggressive rat do it more often (12,00±0,8), than more aggressive (10,36±1,1), the difference is 1.15 fold P<0.05. after 3 minutes we removed more from the dark cell than from the light. Concerning more aggressive ones, they browse the light cell relatively longer (figure 2). Approximately 10 sec they do not enter , it takes them a lot of time to groom in a light cell (8,81±0,7) than less aggressive (7,16±1,1), . the difference is 1.23 fold P<0.05. As if the try to make a right decision in grooming process.

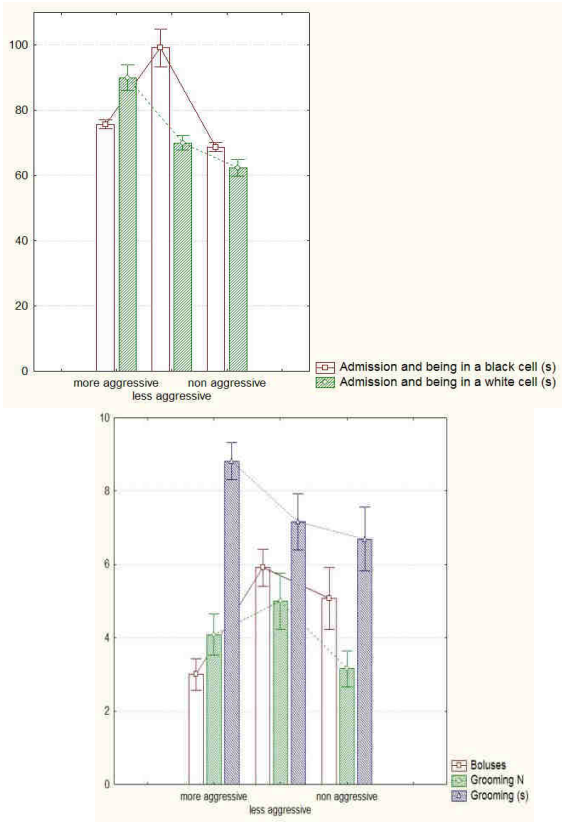


Fig.1: 1) The time of entering in a dark cell. figure12) The time of entering in a light cell.

As it is known from the literature grooming length reveals its dominance. After 24 hours we again place the rat in a light cell and open the door, during 3 minutes we determine the amount of replacements and the time spent in a dark cell. The absence of replacement into a dark cell suggests about the quality of memory good reproduction of memory. The inspection after 24 hours indicated (figure 3, table 1)

that more aggressive rats sit in a light cell , have more time spent on grooming (7,90±0,9) than less aggressive ones (5,00±1,9),. The difference is 1.58-fold, that is statistically reliable P<0.05, as if they want to relieve from stress and make a correct decision.

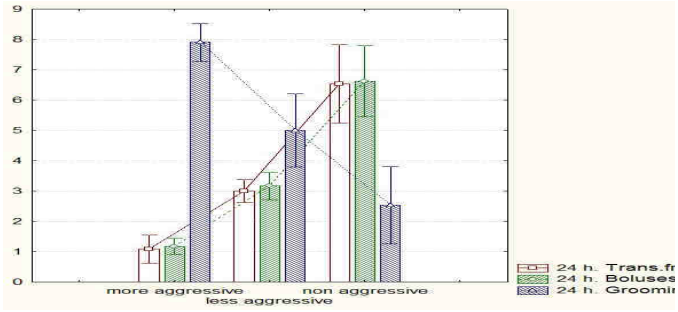


Fig.3: 1. Replacement from light into dark. 2. Amount of boluses after 247 hours. 3. Time of grooming after 24 hours.

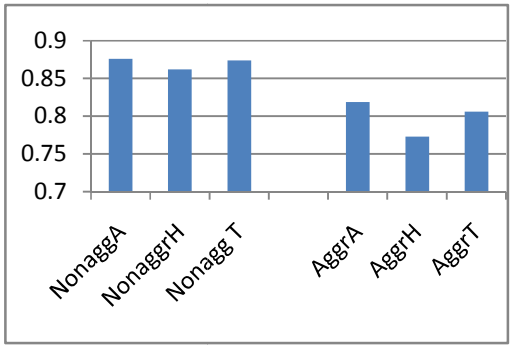
Experiments showed that more aggressive rats have better quality of remembering than less aggressive. Out of 14 less aggressive rats 3 entered, while out of more aggressive only 1 entered. So if we compare aggressive rats with non-aggressive (table 1) we will see that non aggressive enter the dark cell faster than both aggressive and stay there for a little period of time (62,38±4,2), (90,09±5,9), the difference between them and more aggressive is 1.44 fold that is statistically reliable P<0.05. At browsing in a dark cell urination and boluses are more (5,07±1,3) than among more aggressive animals (3,00±0,6) and this difference is statistically reliable 1.69 fold P<0.05.

Thus, we can conclude, that less aggressive animals have more boluses and urination , less replacement from light into dark cell, more head replacement from dark into a light cell and the time spent on grooming is also less than in aggressive rats. At the stage of learning the amount of v\boluses is more and the amount of grooming is less but more than in non aggressive. Regarding reproduction stage, out of 14 rats 3 rats moved into a dark cell. While out of more aggressive rats only 1 removed.

Hence, anatomical, behavioral and pharmacological studies showed, that CNS structures such as almond-shapes structure , hippocampus, prefrontal cortex influence on the decrease of memory based on negative emotions that was more shown in less aggressive animals, than is non-aggressive. We can conclude that the difference in both aggressive animals is very little than in non aggressive. That suggests the high quality of memory and consolidation of aggressive animal.

As one can see in the picture more aggressive rats cover the longer distance than less aggressive ones and non-aggressives cover the less distance, while relating to time they stay on the treadmill rod for a longer time compared to the both of them. In order to define the difference between them we identify the dominant profile and after the animals' decapitation we determine neurochemical profile. Quantitative changes of biogenic amines obtained in the result of the tests are given in the picture 2. The purpose of biochemical study is to prove a leading role of noradrenalin and the secondary role of testosterone in the process of aggression and domination.

Serotonini mkg/g



noradrenali mkg/g

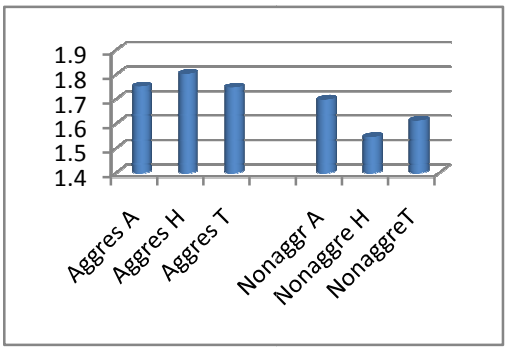


Fig.4: Quantitative changes of serotonin and noradrenalin in rat brain. (amygdala A, hypothalamus H, striatum T).

Pic.2. Quantitative changes of serotonin and noradrenalin in rat brain. (amygdala A, hypothalamus H, striatum T).

In aggressive animals the quantity of noradrenalin compared with serotonin is increased in three sites of the brain. As it is known from the literature, aggressive behavior is energy-dependent behavior that is also proved by our data. In particular, during the study of working capacity and endurance in aggressive animals working capacity increases in aggressive animals, while it is known

from the literature that endurance and working ability increase by activation of glucose transport which is carried out by GLUT4 translocation that is followed by the translocation of glucose to the cell surface and glucagon metabolism synthesis that is manifested by the increase in working ability endurance and adaptation to new environment.

	Aggressive rats amydala	Aggressive rats hypothalamus	Aggressive rats striatum
Noradrenalin/ Serotonin ratio	2,69+0,25	2,38+0,21	2,0+0,16

Note: Difference between amygdale and hypothalamus is reliable. Difference between amygdale and striatum is reliable ($p<0.05$). Difference between hypothalamus and striatum is reliable ($p<0.05$)

Thus, based on the above we can conclude that aggressive animals are distinguished by their workability and endurance, what can be explained by noradrenilne quantity increase (3). The mechanisms of sympathetic nervous system and central nervous system are included into fight/escape reactions. Moreover, the proximity of the regions of hypothalamus and coverage the regions that are involved in defensive reactions, it is clear, that even if noradrenaline does not have another function, the function of metabolic readiness to aggressive attack it still would have (2). Thus it should be considered the main component participated in aggressive behavior. Due to the above mentioned the role of serotonin in aggressive behavior should not be lost. Hence based on the literature as well as on our earlier data, right the ratio of serotonin concentration to noradrenalin represents the organism aggression level and hierarchy rank. These changes definitely reflect on animals' memory and learnability. According to the researches the activation of the energy shifts in aggressive animals effects the fast formation of new protein and all this denotes the high quality of the consolidation and memory of aggressive anima

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