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Research Article

Effects of Auditory Stimulation and Exercise on Gender Hormones in GMOs-Fed Rats

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Abstract

Aim: In this study, it was aimed to investigate the effects of auditory stimuli and exercise on structural measurements, functional characteristics and sex hormones of rats fed with genetically modified organisms (GMO).

Materials and Methods: A total of 64 8-week-old Spraque Dawley rats, 32 male and 32 female, were used in the study. GMO feeding, auditory stimulus and exercise were applied to both male and female rats. Control groups were also formed at the same time as the experimental groups. GMO application; It was fed by mixing 20ml water+20ml corn syrup per day. Auditory application; Segah and Hüseyni maqams were played at 55 decibels loudness for 60 minutes a day. Exercise app; It was applied as challenging swimming in an 80 cm long and 40 cm wide pool.

Results: It was determined that the body weights of all rats treated with GMO showed a significant increase ($p<0.05$). Significant increases in blood lactate levels were observed in exercise-treated rats ($p<0.05$). It was determined that musical auditory stimuli were effective on sex hormones and significant decreases occurred in estrogen levels of female rats fed GMOs ($p<0.05$).

Conclusion: It was observed that the preference of feeding with GMO significantly affected the body composition of the subjects. It was determined that swimming and sound stimuli were effective on sex hormones. It was determined that there was an increase in testosterone levels in male rats fed with exercise and GMO. A significant decrease was determined in the estrogen levels of female rats, especially in those fed with GMOs. For this reason, it was seen that the changes in the sex hormones caused by the high fructose-containing GMO diet can cause very important health problems. It was determined that more research on the subject should be done in order to explain the system response mechanisms of the organism, the relationship between exercise and auditory stimuli and GMO nutrition.

Keywords: GMO, auditory stimulus, exercise, lactate, testosterone, estrogen

INTRODUCTION

The organism, which is derived from the manipulation of an organism by gene sequencing or by trying to give it a new feature that is not in its own, is called a genetically modified organism (GMO) *(Cast, I 2006)*. Genetically modified organisms (GMOs) are organisms that are subject to a genetic change by using various techniques, by changing the gene sequence of the organism or by providing a feature that is not inherent to the gene transfer (Pamuk S 2010, Sungkyoung Lee 2020). The food industry is the most commonly used area of GMO. GMO is preferred in nutrients for many reasons, such as increasing efficiency, prolonging shelf life. The most common GMO product is corn. GMO corn; the main oil is used in the production of flour, starch, glucose syrup and fructose syrup. These products are made of corn, biscuits, pretzels, pudding, waffles, chocolate, candy, soda, chips, ketchup, coated nuts, food, mayonnaise, meat juice tablet, instant soup, coke, it is included in many products, such as juice. It also enters the body through animals consuming GMO corn with animal food *(Costa-Font J 2007, Ozer I 2003, Pusztai A. 2003)*.

The impact of GMO on the human body is a controversial issue. However, studies have been very broad in the literature that GMO has a negative impact on health. Among the things that are said to have caused a change in

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metabolism with unexpected gene interactions, resulting in weight gain, as well as negativity at various blood parameters and hormone levels (Hug, 2008; *Domonkos E, 2017)* can also cause consequences such as cancer, antibiotic resistance and allergies (Hug, 2008).

It is clear that certain work must be carried out to minimize the risks posed by GMO on health. For this reason, there are different ways to recycle the harmful effects caused by GMO. It is known that exercise plays a very effective role in human health. It is often referred to as a method of treatment of metabolic problems or diseases due to hormone imbalance (Niemiro et al., 2020; Woodward et al., 2020). Given the effects of the exercise on hormonal and metabolic levels, it is also possible that GMO will have an effect on these changes. Another remarkable parameter today, besides medication, is the reduction of symptoms of disease with auditory stimuli. They showed that music and nature sounds in front of you reduce pulse rate (Smurf Sky, 2015) in a study on intensive care patients.

In this study, it is aimed to examine body weight and change of gender hormones in rats fed with high fructose corn syrup and to investigate the effect that is produced by exercise and auditory warnings and recycling.

MATERIAL AND METHOD

In the study, 32 female and 32 male Spraque Dawley rats in eight weeks randomly, control, genetically modified organism, auditory stimulus, exercise, the genetically modified organism+auditory stimulus, genetically modified organism+exercise, genetically modified organism+auditory stimulus+exercise groups are divided into eight groups (Table 1). GMO groups were given a mix of 40 ml 50% corn syrup a day, while auditory stimulants played Segah and Huseyni at 60 minutes 55 decibel sound a day, while exercise groups were treated a challenging swimming swim in a 80cm long 40cm pool. Study protocol and experimental methods *Erciyes* University Animal experiments were approved by the Local Ethics Board (Erciyes University 09.03.2016). During the course of the experiment, the rats were kept up to 24±2°C, 12 hours at 12 hours a night, and hours a day in a vinegar rhythm, in plastic cages with wire covers, to receive air above them. at the end of the 28 days, the subjects were silamine (80mg/kg) and xyleasine (5mg/kg) were carried out under anesthesia. Lactate, testosterone and estrogen hormone values were measured on blood samples from abdominal aorta after the laceration.

Table 1. Experimental prosedure and groups. CONT; control group, GDO; Genetically modified organism group, EXC; Exercise group, AUDI; Auditory group, GDO+ AUDI; Genetically modified organism+ Auditory group, GDO+EXC; Genetically modified organism+Exercise group, EXC+AUDI; Exercise and Auditory group, GDO+EXC+AUDI; Genetically modified organism+Exercise+Auditory group

Groups	Number of the subject	Experimental prosedure
CONT	8	The group fed with standard feed with no treatment
GMO	8	GMO-containing feed group
AUDI	8	The group that is listened to music and fed with standard feed
EXC	8	The group subjected to the swim test and fed with standard feed
GMO+EXC	8	The group subjected to the swim test and fed with GMO-containing feed
GMO+AUDI	8	The group that is listened to music and fed with standard feed
EXC+ AUDI	8	The group that is listened to music and the subjected to the swim test and fed with standard feed
GMO+EXC+AUDI	8	The group that is listened to music and the subjected to the swim test and fed with GMO-containing feed

Preparation of GMO food, auditory and exercise applications

A food containing 55% fructose, 42% glucose and 3% glucose polymers was prepared in the preparation of the nutrient that was applied to GMO groups, mixed with high-fructose corn syrup and tap water, containing 50% corn syrup. The reduction was reported by putting this nutrient in the leeches of the animals in the group to be applied to GMO.

Audiovisual alerted groups were played by mobile phone from 10:00 to 11:00 every day, at 55-decibel volume, at the Segah office and the Hüseyni office.

A mandatory swimming test is used for exercise application. The rats were included in the program in groups and exercised in plastic containers with a cylindrical water temperature of 25°C, 80 60cm in diameter of 40cm in 40 minutes for four weeks.

Measurement of hormone levels

The lactate meter was used to measure the lactate level. Blood samples from subjects were carried out using disposable strips, by the instrument instructions. For

lactate measurements, the reference range is 0.5–25 mmol/L (49).

ELISA kits (Sunrise/ Shanghai Chine) were used to measure testosterone and estrogen levels. Blood samples from the abdominal aorta were centrifugated at 3000g for 10 minutes. The serum samples obtained were tested by the procedure specified in the kits and measurements were performed with plate reader assistance.

Statistical Analysis

The data obtained at the end of the operation was evaluated using the Statistical Package for the Social Sciences 22.0 (SPSS 22.0) program in the computer environment. The Shapiro-Wilk test was evaluated and the Independent-Samples t-test was used for parametric data in the cross-group comparisons, whether the parameters have a normal distribution. In cases where variance shows the homogeneous distribution, post hoc Tukey testing was conducted and in cases where homogeneous distribution was not shown, multiple comparisons were made with Tamhane T2 testing. Kruskall Wallis test was used to compare groups in non-parametric data, and was statistically recognized at $p<0.05$.

RESULTS

Weight change

When examining the values obtained from the test start and end of the test, the average weight measurements of the subjects of GDO groups were significantly increased at the end of the experiment ($p<0.05$) (Figure 1).

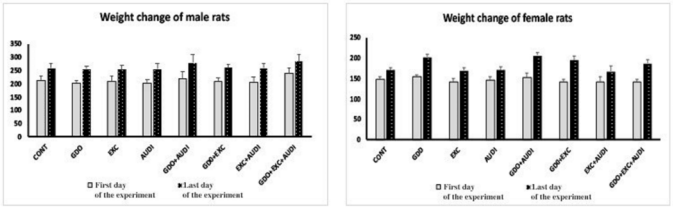

Figure 1. The average weight values of the subjects at the beginning and end of the experiment are shown. CONT; control group, GDO; Genetically modified organism group, EXC; Exercise group, AUDI; Auditory group, GDO+AUDI; Genetically modified organism+Auditory group, GDO+EXC; Genetically modified organism+Exercise group, EXC+AUDI; Exercise and Auditory group, GDO+EXC+AUDI; Genetically modified organism+Exercise+Auditory group

Hormone analysis results

The hormone levels for all subjects are shown in the figure below (Figure 2). Given the data of male rats, a noticeable difference was observed in the exercise groups at serum lactate levels ($p<0.05$). In addition, in comparison with GMO and GMO+AUDI groups, the lactate level in the GMO + AUDI group is lower than the GMO group ($p<0.05$). It has also been observed that the lactate level in the EXC+AUDI and GMO+ EXC group has increased compared to the GMO group ($p<0.05$).

When the testosterone levels of male rats were examined, only the reduction in the AUDI group compared to the CONT group was observed ($p<0.05$). There is no statistically significant difference between other groups ($p<0.05$). Analysis of estrogen levels shows a reduction in GMO +AUDI group compared to the CONT group; there is an increase in the EXC+ AUDI group compared to the GMO group ($p<0.05$).

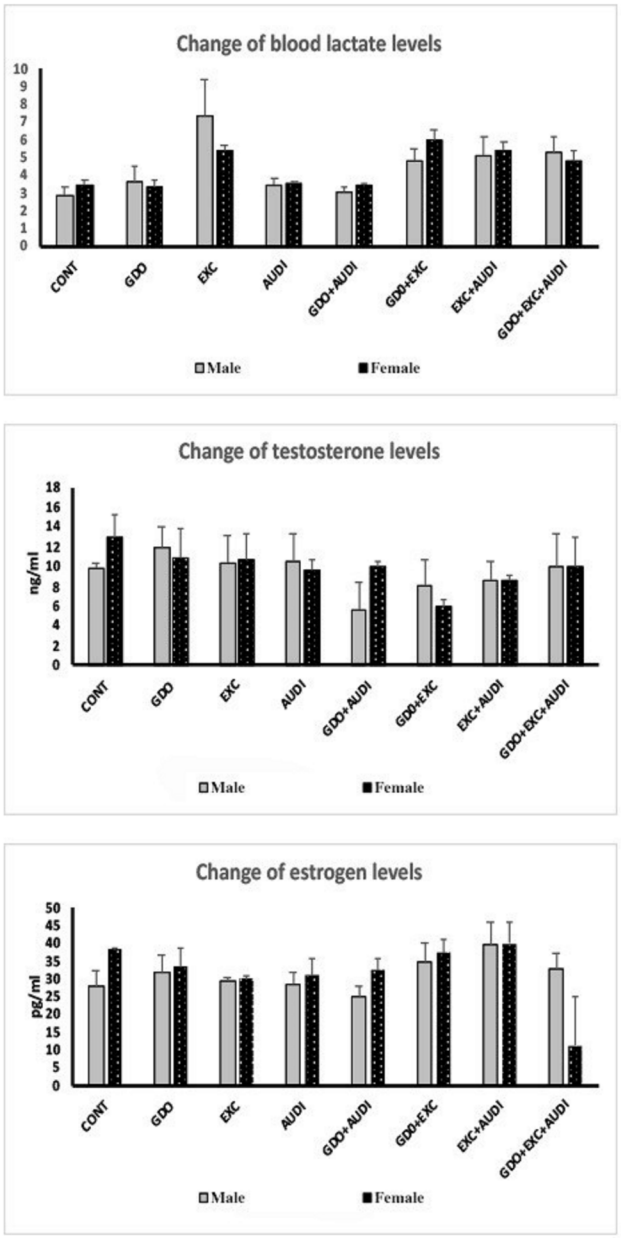

Figure 2. The results (± SEM) of serum hormon level in all groups. A. Serum laktat level results (±SEM) of all groups are showed.There was a significant diffirences between EXCs and CONT group, GDO and GDO+AUDI groups on the male rats. There was a significant diffirences between EXCs and CONT group on the female rats. B. Serum testosteron level results (±SEM) of all groups are showed.There was a significant diffirences between AUDI and CONT group on the male rats, and CONT and EXC+AUDI groups on female rats. C. Serum estrogen level results (±SEM) of all groups are showed.There was a significant differences between GDO+AUDI and CONT groups, GDO and EXC+AUDI groups on the male rats. There was not differences among all groups on the female rats

In a hormone-level analysis of female rats, an increase in serum lactate levels in all EXC groups has been observed compared to the CONT group ($p<0.05$). In testosterone levels, a reduction in the EXC+AUDI group was observed compared to the CONT group ($p<0.05$). While estrogen levels do not have a statistically significant difference between groups, there are easy-to-follow changes ($p\geq0.05$).

DISCUSSION

GMOs is a species of organism that has entered our lives and bodies with food source consumed in our daily lives. GMOs, which are located in many packaged foods, are also available in the food of animals such as chickens. This increases the rate of body ingestion.

The literature on the effects of GMO on health has much questionable information (D'Agnolo, 2005). However, it is known that when an organism is genetically modified, it will have toxic effects if it is not suitable for the composition or operation of the human body (Paparini and Romano-Spica, 2004). Toxic nutrients are the basis for anti-nutrients, autointocchosis or food poisoning. Studies have drawn attention to the fact that GMO has adverse effects on health such as allergic reactions, hormonal changes. In this study, it is intended to demonstrate how much these changes can be affected by changes in the hormone level of rats and exercise and auditory stimulation, using high fructose corn syrup from genetically modified corn.

It is stated in many studies, that the weight of the subjects fed with corn syrup causes an increase or decrease (with behaved, 2014; Mor, 2014). In a study, a total of 20 (12-14 weeks) Swiss albino mice with 10 females and 10 males reported a 2.20g increase in the mice and 3.40g in the females of the mice, the control group fed with corn without GMOs. A weight increase of 1.5g in the males of mice fed with GMO corn and a weight reduction of 4.00g in the females. In mice fed with corn without GMOs, it was determined that the weight increase was higher compared to mice fed with GMOs corn. It has been determined that these increases are statistically significant in the female and male of the control group according to the teeth of the GMO group, and the increase in the men of the control group is not statistically significant compared to the males of the group fed by GMO corn. In terms of gender, it has been determined that there is more weight increase and decrease in the females of both groups, which are fed by GMOs and GMOs corn (Karakuslu S, 2014). In the study, after the fatty diet was given to the groups, there was a significant increase in the weight of the mice in the experiment group according to the control group (Purple B 2014). In this study, GMOs were observed to have a significant weight increase in the teeth of all the groups given. This shows that GMO consumption increases weight and supports many of the studies in this literature. In the weight increase of male rats, the increase was observed, although not as seen in the females in the GMOs. There is no significant difference between the starting and end of the experiment in the GMO+AUDI group only. It was purple and his friends.

The blood is sensitive to changes in lactate concentration, exercise intensity and duration (Beneke R, 2011). Therefore, it is a common variable to estimate the intensity of exercise (Beneke, R 2001). Studies have been conducted on laboratory animals and the blood lactate concentration has been used to determine the exercise intensity (Voltarelli FA, 2002). In a study, it has been reported that the blood lactate level has increased significantly according to the control group in mice undergoing swimming exercise. This study has seen an increase in lactate in all exercise groups in both female and male mice. This result supports the studies in the literature. GMO consumption did not cause a lactate serum level change. However, while the group fed with GMO and auditory was not differentiated with the CONT group, a lactate level decrease was observed compared to the GMO group. Since blood lactate concentration is known to increase by folding with the exercise intensity, it is believed that an increase in lactate levels may be possible, given the soothing properties of music used for auditory stimulation (Voltarelli FA, 2002; Smurf Sky, 2015).

GMO is also thought to have an impact on the reproductive system. In some studies, GMO may have an effect on sterile due to endometriosis, gender hormonal disorder, endocrine-metabolic anomaly (Aris and Paris, 2010; I'm not. Séralini and Moslemi, 2001; Séralini et al., 2012). There are also studies that show that the increase in GMO consumption has negative GMO is also thought to have an impact on the reproductive system. In some studies, GMO may have an effect on sterile due to endometriosis, gender hormonal disorder, and endocrine-metabolic anomaly (Aris and Paris, 2010; I'm not. Séralini and Moslemi, 2001; Séralini et al., 2012). There are also studies that show that the increase in GMO consumption has negative effects in the developmental process (Tyshko et al., 2011; Zhou et al., 2012). This study has examined the change of testosterone and estrogen hormones that play a significant role in the reproductive system with the GMO effect. In testosterone levels, no difference was observed between CONT and GMO groups of both types. Although female rats do not make a statistically significant difference, there are decreased levels of testosterone in the GMO group. There was no study in the literature regarding the effects of GMO on testosterone levels. Although the results of this study show that GMO does not affect testosterone, there is a requirement for further studies to be carried out, given the effects on GMO (Séralini and Moslemi, 2001). Other androgens evaluated in this study are the estrogen hormones. The level of estrogen hormones did not make a significant difference in the group fed by GMOs in both male and female rats. However, the results may not be statistically significant, but the GMO has caused reductions in estrogen levels in female rats; male rats are seen to have caused an increase. These results suggest that the effects of GMO can also make a difference between the sexes. In a study where the effects of the consumption of GMOs plants in the literature are examined, significant increases

in estrogen levels were observed in subjects fed by GMOs plants (Séralini et al, 2012). Given all this, the effect of GMO on estrogen levels is also necessary for a detailed review. Both warnings show different effects. Exercise and auditory members were used in this study to minimize the effects of GMO. Analysis of hormonal levels shows that auditory stimulation causes decreased testosterone levels in the analysis of data from male rats; in female rats, there was no statistical difference, but a decrease was observed. There are many studies that study the effects of music on hormonal secretions (take Doi et, 2018; Kreutz et al., 2012, Borniger et al., 2013). Music is thought to be effective in the neuroendocrine secretions of the brain. A study shows that sophisticated music in men has a negative effect on the testosterone level in saliva; in another study, it has been reported that the level of testosterone is high in women who are dealing with music (Borniger et al., 2013; Doi et al., 2018). The difference in the results of the study suggests that the testosterone and the musical relationship should be investigated in detail. In addition, the exercise is in studies that show that the testosterone level is reduced. It reduces testosterone levels of cortisol increased by exercise (Brownlee et al., 2005). While this study shows a decrease in testosterone levels in exercise groups, this decrease did not make a statistically significant difference. In addition, a significant difference in testosterone levels has been observed in the group that has both auditory warning and exercise stimulus for female rats. These results support that the exercise is associated with the testosterone level.

Studies show that music affects levels of steroids such as estrogen, receptor genes and related proteins (Fukui and Toyoshima, 2008). In this study, estrogen levels were measured in both male and female rats. While estrogen levels have decreased in the auditory quasi-given group in male rats, but this decrease does not make any statistical meaning, the increase in GMOs is the exact opposite of GMO+ AUDI group and results in a statistically significant decrease, this increase does not mean statistically significant. However, this increase is very meaningful when considering cognitive effects on estrogen level and musical capability in females (Fukui and Toyoshima, 2008). The increase in the exercise warning in the females has increased the mi estrogen levels, but this increase has not statistically expressed meaning. Estrogen is a hormone that plays an important role in muscle contractions and repair. Although the mechanisms in which estrogen applies its effect on skeletal muscle damage, inflammation, and repair indicators are not fully illuminated, it is believed that the effects of estrogen are potentially preventive by acting as antioxidants (Enns and Tiidus, 2010). it's being watched. This is to be said that auditory stimulation causes a decrease in the estrogen level in men and the female rats.

CONCLUSION

lthough there is a change in the hormonal level, given all the results in our work, many of these changes do not mean statistically. This can be explained as the difference between individuals in groups and the high deviation values. In this study, there have been differences between the sexes in hormonal changes. This indicates that GMOs and auditory and exercise stimulants have different effects between sexes. In addition, in the light of all analyzes and literature, detailed and comprehensive work has been planned to describe the effects of both GMO nutrition and hormonal changes and their mechanisms.

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Conflict of Interest: *The authors declare that they have no competing interest.*

Ethical approval: *The compliance of the method applied on animals during this study with animal rights and animal experiment ethics was approved by the decision of Erciyes University, Experimental Animals Local Ethics Committee dated 09.03.2016 and numbered 16/051.*

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