

Research Report

Changes of the sweet taste sensitivity due to aerobic physical exercise

Ni Luh Putu Ayu Wardhani¹, Anis Irmawati², and Jenny Sunariani²

¹Dental Student

²Department of Oral Biology

Faculty of Dentistry, Airlangga University

Surabaya - Indonesia

ABSTRACT

Background: Sweet taste is a pleasant sensation. Sweet taste is mostly consumed and fancied by many people. Physiologically, glucose is body's source of energy, but if over used it can be affected to the body's metabolism. This can be worsen if the person's not doing a healthy lifestyle. One way to implement a healthy lifestyle is by doing physical exercises. **Purpose:** The aim of this study was to determine changes in sensory sensitivity of sweet taste due to aerobic physical exercise. **Methods:** This study was conducted on subjects aged 20 to 30 years. The subjects did aerobic exercise using 80% load of MHR. The measurement sensitivity of the senses of the sweet taste was done for three times before the subject take aerobic physical exercise, four weeks after doing aerobic physical exercise, and eight weeks after doing aerobic physical exercise. **Results:** There was significant difference towards sensitivity of sweet taste sense before doing aerobic physical exercise, 4 week after doing the aerobic physical exercise, and 8 week after doing aerobic physical exercise. **Conclusion:** Aerobic physical exercise during eight weeks increase sweet taste sensitivity.

Key words: Sense of taste sensitivity, sweet taste, aerobic physical exercise

ABSTRAK

Latar belakang: Rasa manis memberikan sensasi yang menyenangkan. Rasa manis merupakan jenis rasa yang paling banyak dikonsumsi dan disukai oleh sekelompok orang. Secara fisiologis, glukosa bisa berperan sebagai sumber energi, namun apabila dikonsumsi secara berlebihan dapat menimbulkan efek patologis. Hal ini dihubungkan dengan individu yang mempunyai gaya hidup yang tidak sehat. Salah satu cara yang bisa dilakukan untuk membiasakan gaya hidup sehat adalah dengan latihan fisik (olah raga). **Tujuan:** Penelitian ini bertujuan untuk membuktikan adanya perubahan sensitivitas indera kecap rasa manis setelah melakukan latihan fisik aerobik. **Metode:** Penelitian ini melibatkan subyek laki-laki, berusia 20–30 tahun. Subjek melakukan latihan fisik aerobik dengan intensitas sebesar 80% maximal heart rate. Sensitivitas indera kecap rasa manis diukur 3 kali, yaitu sebelum melakukan latihan fisik aerobik, dan 4 serta 8 minggu setelah latihan fisik aerobik. **Hasil:** Terdapat perbedaan yang signifikan pada sensitivitas indera kecap rasa manis sebelum 4 dan 8 minggu sesudah latihan fisik aerobik. **Kesimpulan:** Latihan fisik aerobik selama 8 minggu menyebabkan peningkatan sensitivitas indera kecap rasa manis.

Kata kunci: Sensitivitas indera kecap rasa manis, rasa manis, latihan fisik aerobik

Correspondence: Ni Luh Putu Ayu Wardhani, c/o: Pendidikan Dokter Gigi, Fakultas Kedokteran Gigi Universitas Airlangga. Jl. Mayjend. Prof. Dr. Moestopo no. 47 Surabaya 60132, Indonesia.

INTRODUCTION

Sweet taste is one of the five basic tastes that are considered as a pleasant experience. Supartono research

states that sweet is a taste with more popularity and more consumed by the Indonesians.¹ Physiologically, the sweet taste derived from glucose which is the body's main source of energy, but when consumed in excess will have

an impact on the body such as pathological obesity and diabetes mellitus.² The major problem that often occurs in the oral cavity is dental caries. The prevalence of dental caries in developed countries continues to decline, while in developing countries like Indonesia there is a tendency to increase. The data showed about 80% of Indonesia's population has broken teeth caused by different factors, but the most common is dental caries. Statistics showed that there is an average of two to three caries lesions in Indonesia population.³ Household health survey (NHHS) in 2004 showed that the prevalence of dental caries in Indonesia reached 90.05%. Data from the Ministry of Health also showed that the number of complaints of a toothache because caries is high, which is 1.3% or 2620 people every month.⁴

Caries prevalence is quite high in Indonesia leading to an alternative measures of prevention which is a priority attempts to curb the prevalence of teeth. The prevention of dental caries that has been done, such as improving nutrition, reducing the consumption of cariogenic diet, improving oral hygiene, the provision of systemic or topical fluoride and fissure sealant with adhesive materials. Yet those efforts still do not provide optimal results.^{5,6} One way to implement a healthy lifestyle is to exercise regularly. In general, physical exercise is an activity that a person intentionally done by taking the time to train the body, not just physically, but also spirituality which is focused to maintain a balanced mind. So with physical exercise, a healthy physical condition as well as psychological condines.⁷

There are two types of physical exercises there are aerobic exercise and anaerobic exercise. Aerobic exercise is an intense physical exercise, which can speed heart rate and is done for long periods of time, for about 20 minutes. This exercise strengthens the cardiovascular system and can burn glucose and fat stored in the body. Activities such as jogging, swimming, dancing, brisk walking and cycling are examples of aerobic exercise. This type of anaerobic exercise performed for a short period of time, useful to help strengthen the muscles and joints. Activities like weight lifting and running are examples of anaerobic exercises.⁷

In one exercise, various systems in the body are involved and work together. Muscular system has a more prominent role, the blood circulation as a means of transport will run more smoothly, the nervous system as a "relay system" which coordinates the body's system can work faster, so it is with the hormone could help in an optimal metabolism. By doing aerobic physical exercise is expected to serve local circulation of the oral cavity, including the tongue that contain many taste buds become more optimal.⁸ The purpose of this study was to determine whether aerobic physical exercise can increase the sweet taste sensitivity. It expected that exercise can be used as one more effort to dental caries prevention research due to decreased consumption of cariogenic materials.

MATERIALS AND METHODS

The research is quasi experimental research conducted in the Physiology laboratory Faculty of Medicine, Airlangga University, Surabaya. This study used 10 student subjects people Faculty of Dentistry Airlangga University, male, aged 20-30 years who had the criteria of good general health condition (no history of systemic disease), oral cavity healthy condition and there are no lesions or abnormalities in the tongue and oral cavity, not smoking and drinking alcohol, height 165-170 cm with an ideal body weight. Age 20-30 years sample set on the grounds of cardiovascular endurance can be increased to maximum. The male sample was chosen to eliminate hormonal influences on taste sensitivity.

The subjects were measured the sweet taste sensitivity before doing aerobic physical exercise for the first time, then the subject using a belt heart rate and did aerobic physical exercise (up and down the bench) using intervals of 1:1, i.e. the subject up and down the bench for five minutes to the beat 80 times per minutes, followed by rest 5 minutes. Activities carried out for 20 minutes, 3 times a week, for 8 weeks. At week 4 and 8 measured the sweet taste sensitivity. To measure the sweet taste sensitivity, subjects were instructed to use aquades rinse, then dried with a tissue of the tongue subjects. At the tip of the tongue of subjects, using a pipette drops of sucrose solution starting from the lowest concentration, i.e. 0.003 M. At every turn of the concentration of sucrose solution, subjects were instructed to rinse using aquades three times, then rested for 2 minutes.¹⁰ After that the tongue is dried using a tissue, and begin again drops a sucrose solution with a greater concentration (0.01 M: 0.013 M: 0.017 M: 0.022 M; 0.029 M).⁹ When the subject has felt the sweet taste, they were told to sign by raising their hand.

Measurement of the sweet taste sensitivity was conducted in the morning at 07.00 am according to circadian rhythms and hormonal changes of cortisol¹¹ with instructions to the subject to sleep and last consumption after 22.00 pm, and the samples were told not take breakfast. The goal is for homogenization and to minimize the retrieval of psycoadaptation factors, such as people who drank sweet tea before will be less sensitive to sweet taste than people who previously drank water.

RESULTS

ANOVA test was performed among groups which showed significant differences among groups before treatment, after 4 weeks, 8 weeks of physical exercise (Figure 1).

First data distribution was tested using Kolmogorov-Smirnov One Sample test. The results of the test was that data distribution obtained were normal. Then ANOVA

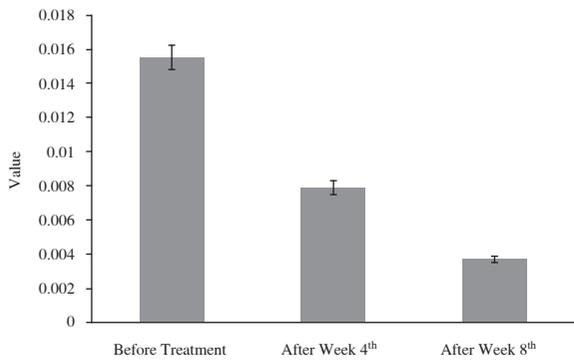


Figure 1. The average and standard deviation of sweet taste sensitivity before and after the fourth week, the eight week of exercise.

test was performed between groups. The results obtained was significant between groups before treatment with 4 weeks after treatment and 8 weeks after treatment (Table 2).

Table 1. Result of different test of the sweet taste sensitivity between groups

Group	Group	Significance
1	2	.000
	3	.000
2	1	.000
	3	.015
3	1	.000
	2	.015

Description: Group 1: The sweet taste sensitivity before physical exercise; Group 2: The sweet taste sensitivity 4 weeks after physical exercise; Group 3: The sweet taste sensitivity 8 weeks after physical exercise.

There are signofocant differences in sweet taste sensitivity among groups before physical exercise, after 4 weeks, and 8 weeks of physical exercise (Table 1).

DISCUSSION

Taste is the main function of taste buds in the oral cavity. The function of taste allows humans to choose food according to his/her wishes and in accordance with the needs of the tissue about the substance of certain nutrients. Taste cells continuously replaced by mitosis of the cells around it every 10–11 days. The cellular mechanism how human feel the sweet taste is as follows: the transmission of impulses of the senses of sweet taste through G protein complex which activates second messengers or the adenylyl cyclase to trigger the conversion of adenosine triphosphate (ATP) to cyclic Adenosine 3'5' Monophosphate (cAMP). The available cAMP activates protein kinase A so there are phosphorylation of K ion channels. K ion channels close and the depolarization occurs so that neurotransmitter is released and the stimulation of sensory neurons occurs so that the sweetness be felt.^{11,12}

Sense of taste sensitivity in humans, can be influenced by age, sex, food temperatures, local and systemic disease and the number of taste receptor cells. Increasing age led to decreased taste sensitivity. This is due to the decreasing number of taste buds on the papillae fungiformis per square centimeter of surface area on the tongue and on the circumpalatinal papillae. The sensitivity of taste declines with degeneration of taste buds after 45 years old. In addition, the influence of age can cause decrease tone of muscle tongue, lining and tongue papillae disappear into atrophy. The gender difference of taste sensitivity indicates the sensitivity of taste in women is higher than men because women have more taste receptors.¹³

Based on the results of research which has been conducted on 10 subjects, at a time before doing aerobic physical exercise, the subjects had a sweet taste sensitivity varies (above the threshold value of sweetness). At fourth week after doing aerobic physical exercise increased the sweet taste sensitivity than before doing aerobic exercise. At the eight week after doing aerobic exercise, the increased sweet taste sensitivity is more significant. Physical exercise can provide a change in the function of body systems. Increased heart rate during exercise is a response from the heart, but after a long practice then slowly the heart rate becomes stable because of the strength of heart muscle to pump blood increases. This is an adaptation of the heart to undertaken the physical exercise. The more heavy the physical activity performed during exercise, the greater the need for oxygen in the body. To compensate for this, the heart and circulatory system must work hard to give the needs of oxygen and nutrients that are increasing in the tissue, starting with the physiological changes and in a relatively long time will change the morphology consistently.¹⁴

In the blood circulation system, physical exercise can improve the use of capillary blood vessels. The impact of this situation will cause the increase of blood into the tissues that are active. Increased blood volume and the number of red blood cells will occur anyway, which means increasing the capacity of the blood to bring oxygen.¹⁵ In the muscular system, regular physical exercise can increase muscle mass, because the exercise will stimulate muscle cells to grow larger and the muscle cells that initially breaks will become active again. Supply of food and oxygen grow well too. Disposal of CO₂ and lactic acid becomes more fluently. Thick muscle fibers also increased due to energy reserves in the form of ATP, phosphocreatine, and glycogen.¹⁶ In the respiratory system, people who exercise have a high endurance because the lungs have the ability to accommodate air 1½ times more than ordinary people (VO₂ max). When doing training, the lungs can take in more oxygen, which means better blood circulation, and muscle cells get more oxygen from the capillary blood vessels.¹⁷

During exercise, the body requires fuel/ energy. The energy generated from glucose is then metabolized by the mitochondria produce ATP. When the body requires

energy, ATP will be disconnected and removed a single molecule to be adenosine diphosphate (ADP). ADP is still able to take off again into a single molecule phosphate adenosine mono phosphate (AMP). AMP then transduced by cAMP thus stimulating the entry of glucose into the muscle. Because the body transfer of glucose from the blood into muscle cells, this process will reduce the amount of glucose in blood.¹⁸

At the time of exercise, glucose uptake for cell metabolism is not affected by insulin. After doing aerobic physical exercise, insulin plays a role in facilitating the re-entry of glucose into the cells. Another thing that happens is that these cells become more sensitive to insulin because while doing physical exercise, glucose can enter on its own without the help of insulin. With the increase in insulin sensitivity, blood glucose uptake is increased and will decreased blood glucose levels automatically. The impact, regular exercise can improve the body's response to insulin and help insulin work more efficiently.¹⁴ With frequent exercise, 80% of maximal heart rate constantly and continuously will automatically adapt the heart muscle so that the strength of the heart in pumping blood will be more improved than before exercise.⁷ Aerobic physical exercise can cause increased heart rate through two pathways, the first its through autonomic nervous system which then stimulates the sympathetic nervous system so that release of neurotransmitters nor epinephrine and the second pass through the hypothalamus which is the central receptacle of all information, then continue through the stimulation and release of anterior pituitary cortico releasing hormone (CRH). CRH affects the adrenal cortex to release adeno cortico tropic hormone (ACTH) which then affects the medulla of the adrenal glands to release adrenaline. Increased heart rate will affect the capacity of blood that bring nutrients and oxygen so that oxygen will quickly get to the tissue. Because the heart's performance and microcirculation is better so nutrients and oxygen supply to the cells of the taste bud adequate, by itself taste bud cells may be working according to their function well.¹¹

The long-term effects of aerobic physical exercise can lead to increased regeneration of taste receptor cells. Synthesis of receptor obtained from protein material. Growth hormone (somatotropic hormone) can assist protein synthesis by increasing amino acid transport and stimulates the synthesis of ribosomal proteins. Growth hormone increases amino acid transport across the cell membrane to the inside of the cell. This situation increases the concentration of amino acids in the cell and contribute to increased protein synthesis. Growth hormone also stimulates the transcription of DNA in the nucleus, thereby increasing the amount of RNA formation. Increased translation of RNA led to the synthesis of protein by ribosomes. Even when amino acids are not increased in the cell, growth hormone still stimulate increased translation of RNA, causing enhance the amount of protein synthesized by ribosomes in the cytoplasm.¹⁸

Increasing number of receptors followed by increased expression of taste receptor cells so that cells will make

more responsive and can increase the sweet taste sensitivity. The process of formation of new taste receptor cells that normally takes place every 11 days will be happened faster, because it receives the supply of nutrients and oxygen from the blood optimally. This will increase the sweet taste sensitivity.¹¹

When the senses of sweet taste is more sensitive due to aerobic physical exercise in a long time, this will decreased the consumption of glucose/ sucrose (cariogenic material). Decrease in glucose consumption coupled with improving nutrition, improving oral hygiene, the provision of systemic or topical fluoride and fissure sealant is expected to reduce the incidence of caries. In addition to caries, of course, long-term physical exercise can also lower the risk of diabetes mellitus, but this certainly requires further research.

It is concluded that erobic physical exercise for 8 weeks could led to increase the sweet taste sensitivity.

REFERENCES

1. Supartono. Healthy food menu. New York: Scholastic Press; 2005. p. 7.
2. Mahardika. Healthy mouth in the age of 30, 40, 50. Available from: <http://cyberman.cbn.net.id>. Accessed February 2, 2010.
3. Kawuryan U. Relationship awareness dental and oral health dental caries in Children's Genesis II SDN Kleco class V and VI District Laweyan Surakarta. Available from: <http://www.etd.eprints.ums.ac.id/897/J210040006.pdf>. Accessed May 10th, 2010.
4. BSMI-YDSF. Healthy Kartini title. Available at: <http://bsmi-surabaya.or.id>. Accessed May 10, 2010.
5. Sundoro EH. New concept of caries treatment. Faculty of Dentistry, University of Indonesia. Available from: <http://www.pdpersi.co.id/show=detailnews&kode=107&tbl=artikel.JNI>. Accessed 18, 2010.
6. Roeslan BO. Barriers to dental caries occurrence after immunization with Streptococcus mutans glucosyltransferase INA99 are applied in oral mucosa: Study on types of Wistar rats. Dental caries Research. Available from: <http://jrnal.dikti.go.id>. Accessed May 1st, 2010.
7. Winarno F. Benefits of Exercise. Available from: <http://duniaolahraga.com>. Accessed January 10, 2010.
8. Soerjodibroto W. Sports nutrition. New York: PJO KONI-FKUI; 1999. p. 35–8.
9. Ganong WF. Review of medical physiological. 21th ed. San Francisco: Lange Med Books/McGraw Hill Med Publ Div; 2005; p. 344–8, 514–27.
10. Ariesty DS. Sensitivity difference to the sweet taste sense taste smoker and non-smokers. Thesis. Surabaya: Faculty of Dentistry Airlangga University; 2008. p. 38.
11. Guyton AC, Hall JE. Textbook of medical physiology. 11th ed. New York: WB Saunders Co; 2006. p. 419–29, 699–707.
12. Ramos E, Johanningsmeier SD, McFeeters RF. The chemistry and physiology of taste. Concise and hypothesis in food science. 2007; p. 36–8.
13. Bowen R. Taste Sensation. Available from: <http://www.doctorsaloe.com/oftastephysiology>. Accessed January 14, 2010.
14. Willmore JH. Athletic training and physical fitness. Boston: Allyn and Bacon Inc; 1997. p. 20–6.
15. Vander A, Sherman J, Luciano D. Human physiology, the mechanism of body function. San Francisco: McGraw Hill; 2001. p. 219–21, 380, 452–60.
16. Lersten, K. Physiology and physical conditioning. California: Peek Publications; 1997. p. 56.
17. Moeloek D. Health and sports. Faculty of Medicine, University of Indonesia. New York: Publishing Center of Faculty of medicine; 1999. p. 7–23.
18. Sherwood L. Human physiology, from cell to system. 5th ed. United States: Thomson Brooks/ Cole; 2004. p. 709–19.