Giving Ginger and Lemongrass Drink Increase Total Antioxidant Status Level on Adolescent Football Athletes After Physical Exercise

Miftahul Adnan[1],* Diana Nur Afifah[1], Gemala Anjani[1], Hardhono Susanto[2], Etika Ratna Noer[1], Sumardi Widodo[2]

[1] Nutrition Department, Faculty of Medicine, Diponegoro University, Semarang Central Java 50275 Indonesia
[2] Department of Anatomy, Faculty of Medicine, Diponegoro University, Semarang Central Java 50275 Indonesia
adnan@unimus.ac.id

Abstract. Physical exercise can increase the production of Reactive Oxygen Species (ROS) in the body. An imbalance of oxidants and antioxidants in the body can cause oxidative stress. Oxidative stress can cuase cell damage and is the basis of pathogenesis for chronic disease process such as cardiovascular, autoimmune, pulmonary, metabolic disorder and aging. Ginger and lemongrass is a herbal medicine were contain bioactive compound as antioxidant. This study aim to determine the effect of giving ginger and lemongrass drink on total antioxidant status (TAS) level in adolescent football athletes. Experimental research with a pre and post control group design. Subject are 24 adolescent football athletes of PS Undip Semarang. Subject were divided into 2 group, controls groups and interventions groups. The intervention group given ginger and lemongrass drink with brown sugar sweetener. The control group was only given brown sugar drink. Intervention are given after training for 28 days namely 4x/week for 7 weeks. The dosage for the ginger and lemongrass drink is 3g in 150ml of water. Blood samples were collected and tested after exercise by professional laboratory. TAS were measured using the Enzyme Linked Immunosorbent Assay (ELISA) method. The result of the study found there was significant differences (p=<0,05) TAS level after giving ginger and lemongrass drink. There was significant differences (p=<0,05). TAS level between the intervention group and the control group after giving the ginger and lemongrass drink. In conclusion, there was enhance total antioxidant status level after giving ginger lemongrass drink for 28 days.

Keywords: Physical Exercise, Ginger, Lemongrass, Total Antioxidant Status

1 INTRODUCTION

Football is one of sport with the high intensity an intermittent stop and go that requires endurance, speed and strenght.[1] Physical execise can provide a physical stressor that can disrupt the balance of the body's metabolism, causing a feedback respone form the body's organs to the training load in the form of an increase in respiratory frequency and an increase in heart rate.[2] Physical exercise can the trigger an cause an increase in

K. Nugraheni et al. (eds.), *Proceedings of the 2nd Lawang Sewu International Symposium on Health Sciences: Nutrition (LSISHSN 2023)*, Advances in Health Sciences Research 80,
https://doi.org/10.2991/978-94-6463-550-8_21

oxygen consumption 10-20x in the body and oxygen consumption by muscle fibers increase 100x which can trigger the production of free radicalls or Reactive Oxygen Species (ROS).[3] An imbalance between ROS production and antioxidant in the body causes oxidative stress.[4] Oxidative stress can cause cell damage and is the basis of pathogenesis for chronic disease process such as cardiovascular, autoimmune, pulmonary, metabolic disorder and aging.[5]

Total antioxidant status (TAS) is an indicator that can be used to determine the total ability of plasma to capture or neutralize free radicals.[6] ginger and lemongrass are herbal plant that contaion bioactive compound as a antioxidant and inflammation.[7] Ginger contain a secondary metabolite namely (*gingerol, shogaol and paradol*) which funtcion as antioxidant.[8] The potential mechanism of antioxidant action in ginger is that the compound *6 shogaol* activates the nuclear factor erythroid 2 – related factor 2 (NrF2) signaling pathway and increase the expression of the NrF2 target gen (endogenous antioxidant gene).[9] lemongrass has secondary metabolite compounds such as saponins, tannins, alkaloid, Tannins, alkaloids, steroids, phenols and flavonoid which have the potential to act as antioxidant.[10] The flavonoids in lemongrass can shorten the inflammatory phase by eliminating ROS, detoxifying hydrogen peroxide (H_20_2) theraby reducing lipid peroxide level.[11] The study antioxidant activity of ginger showed IC_{50} are 77,03% it means ginger has strong antioxidant properties.[12] A study shows that the antioxidant activity of lemongrass has IC_{50} value for methanol extract from lemongrss stems namely 67.18 mg/mL and an IC_{50} for the ethyl acetate fraction of 68,96 mg/ml, so that lemongrass stems have the potential for strong antioxidant activity.[13]

2 METHOD

Experimental research with a pre and post control group design. Subject are 24 adolescent football athletes of PS Undip Semarang were selected as a a sample through purposive sampling. The criteria for the subject are subject are registered as football athlete in PS Undip Semarang, aged 15-18, subject signed informed consent of the reseach, Body Mass Index (BMI) 18,5 – 25 BW/m2 , do not take suplement for research, no injured,, no smooking, do not consume alcohol and do not take pain medication.

Anthropometric measurements included weight and fat mass percentage are measured using Biolectrical Impedance Analyzer (BIA) Omron HBF 375, Height is measured using a stadiometer tool SECA brand with precision 0,1 cm.

Subject were divided into 2 group, controls groups and interventions groups. The intervention group given ginger and lemongrass drink with brown sugar sweetener. The control group was only given brown sugar drink. Intervention are given after training for 28 days namely 4x/week for 7 weeks. Giving the ginger and lemongrass drink after excercise. The dosage for the ginger and lemongrass drink is 3g in 150ml of water. Blood samples were collected and tested after exercise by professional laboratory. The Physical exercise includes running around the field 5x, shuttle run with a distance 10m for 2 minutes, sit up 30x, push up 30x, squat thrust jump 30x. Total

antioxidant status (TAS) were measured using the Enzyme Linked Immunosorbent Assay (ELISA) method. The research was carried out after the issuance of ethical clearence number 168/KE/03/2024 from the Ethics Comission of the faculty of nursing and healthy University of Muhammadiyah Semarang. Univariate analysis was used to describe the characteristic of respondents using mean and standar deviation such as Body weight, height, aged, Body Mass Index and body fat percentages. The normality data test using shapiro wilk test. Paired t test or wilcoxon used to determine the difference of mean total antioxidant status before and after intervention in each group. Independent t test or mann whitney used to determine the difference of mean toal antioxidant status between the intervention and control group.

3 RESULTS AND DISCUSSION

Table 1 presents the characters of aged, body weight, height, body mass index and body fat percentage.

Table 1. Subjects Characteristic

Characteristics	Control group (n = 12)		Intervention group (n=12)		*p* value
	Mean +SD	min – max	Mean+SD	min-max	
Age	16,42 + 0.515	16 – 17	16.58 + 0.515	16 - 17	0.514**
Weight	61.97 + 3.64	57.20 – 68.0	60.64 + 7.02	51.20 – 76.0	0.569*
Height	169.27 + 4.54	161,50 – 176	168,36 + 5,45	161 – 177,20	0,662*
Body mass index (kg/m^2)	21,67 + 1,71	19,49 – 24,73	21,35 + 1,68	19,05 – 24,20	0,651*
Fat mass (%)	12,35 + 3,29	7,30 – 17,40	13,20 + 4,03	8,90 – 19,50	0,799**

*independent t test ** Mann Whitney test

Based on Table 1 body mass index of the respondents was normal, namely 21.67 kg/m^2 in the control group and 21.35 kg/m^2 in the intervention group. Body Mass Index (BMI) respondent were all in the normal category according to the inclusion criteria in this study. The body fat percentage of respondents is 13.20% for the intervention group and 12.35% in the control group. The results of the body fat percentage are all in the normal category (10-20%). Based on the independent t test and Mann Whitney, the parameters of age, weight, height, BMI and body fat percentage between the control and intervention groups have a p value > 0.05, meaning there is no difference in data between the control and intervention groups.

The results of total antioxidant status test respondents after given ginger and lemongrass drinks can be seen in Table 2. Based on Table 2, the results of the independent t test before intervention between intervention and control group showed p value of 0.563, it means there was no difference in the average TAS levels of respondents. The result of the independent t test after intervention between intervention and control group showed p value 0.001 it means there was differences in the average TAS levels of respondents.

Table 2. Total Antioxidant Status Level Before and After Intervention

TAS level (mmol/L)	Control group		Intervention group		P value
	Mean + SD	Min – Max	Mean + SD	Min – Max	
Before Intervention	1,67 + 0,23	1,35 – 2,12	1,62 + 0,18	1,29 – 1,91	0,563*
After Intervention	1,21 + 0,50	0,37 – 1,74	2,08 + 0,34	1,32 – 2,53	0,001*
Δ TAS	-0,46 + 0,49	-1,36 – 0,31	0,46 + 0,40	-0,33 – 1,01	0,001*
P value	0,008**		0,002**		

**independent t test analysis **paired t test analysis*

The results of the paired t test in the control group showed p value of 0.008. This means that there is a difference in the average TAS in total antioxidant levels. The results of the paired t test in the intervention group showed a p value of 0.002, meaning that there was a difference in the average TAS levels before and after the intervention. There was an increase in TAS levels in the intervention group, namely 0.46 mmol/L and the control group there are decrease TAS level namely 0.46 mmol/L.

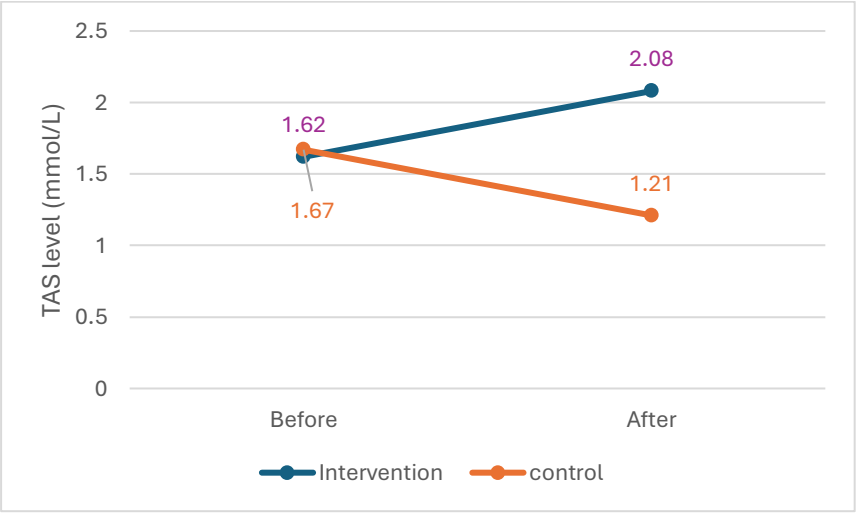

Fig. 1. The increase and decrease TAS level after giving ginger and lemongrass drink

Ginger and lemongrass have strong antioxidant activity.12,13 The antioxidant compound of ginger has the potential to control oxidative stress. Essential oils and oleoresins such as zingiberene, zingiberol, shogaol, curcumin, gingerol and zingerone are phenolic compounds. Phenolic compounds are organic compounds that have at least one aromatic ring with one or more hydroxyl groups. Phenolic compounds as antioxidants because of ability to stabilize free radicals, namely by giving hydrogen

atoms quickly to free radicals, while the radicals originating from antioxidant phenolic compounds are more stable than free radicals.[14] The antioxidants in ginger will transfer protons to DPPH radicals by direct abstraction of the H-phenol atom and through an electron transfer process, so they are able to neutralize the free radical properties of DPPH-H which has lower reactivity than DPPH. Ginger is also able to increase antioxidant production in the body.[15]

Oxidative stress occurs in our body when the antioxidant mechanism does not function, resulting in an imbalance in the production and elimination of ROS. Some effects are caused by activation of the nuclear factor erythroid 2 – related factor 2 (NrF2) signaling pathway. The potential action of antioxidant in ginger is 6-shogaol leads to translocation of NrF2 into the nucleus and increases the expression of NrF2 genes target by modifying Kelch-like ECH-associated protein 1 (Keap1) and preventing NrF2 from proteasomal degradation so that GSH levels increase and ROS levels decrease.9 Lemongrass have secondary metabolite compounds such as saponins, tannins, alkaloids, steroids, phenols and flavonoids which have potential as antioxidants, anti-inflammatory, antibacterial, anticancer, antimicrobial and antidiabetic.10 The phenolic compounds in lemongrass can inhibit the NFkβ (nuclear factor kappa β) pathway and cytokine expression. Lemongrass is also a "scavenger" of free radicals/ROS which acts as a potential contributor to chronic kidney disease (CKD) inflammation, which plays its anti-inflammatory role.[16]

A study reported that lemongrass extract can reduce the concentration of oxygen species reactions, lipid peroxidation and DPPH. Lemongrass extract can also support the endogenous antioxidant defense system in alveolar macrophage cells by increasing the activity of superoxidase dismutase (SOD) and the formation of glutathione peroxidase (GPX).[17]

4 CONCLUSION

The result of this research was there was increase total antioxindant status level after giving ginger and lemongrass drink for 28 days on adolescent football athletes (p value 0,002)

References

1. Nicolai Ré, A. H., Cattuzzo, M. T., Henrique, R. dos S., & Stodden, D. F. Physical characteristics that predict involvement with the ball in recreational youth soccer. Journal of Sports Sciences. 2016 ; 34 (18) :1716-1722.
2. Gabriel, B. M., & Zierath, J. R. The limits of exercise physiology: from performance to health. Cell metabolism. 2017;25(5):1000-1011.
3. Ji, L.L. (1999), Antioxidants and Oxidative stress in exercise. Society for Experimental Biology and Medicine, 283:292.
4. Yoshikawa, T., & Naito, Y. What is oxidative stress? JMAJ. 2002;45(7): 271–276.
5. Halliwell B & Gutteridge JMC. Cellular response to oxidative stress : adaptation, damage repair, senescence and death. In Free Radical in Biology and Medicine. 4th ed. London, Oxford : University Press ; 2007. 187 – 267

6. Randox Laboratories Ltd. 1994. Total Antioxidant Status. Ardmore, Diamond Road, Crumlin, Co. Antrim, United Kingdom. BT294 QY
7. Ballester, P., Cerda, B., Arcusa, R. et al. Effect of Ginger on Inflamatory Disease. Molecules.2022; 27: 7223. 1 – 13
8. Mao, Q.Q., Xu, X.Y., Cao, S.Y et al. Bioactive Compounds and Bioactivities of Ginger (Zingiber Officinale Roscoe).Foods.2019;8:185 doi:10.3390/foods8060185
9. Nile, S.H. & Park, S.W. Chromatographic analysis, antioxidant, anti-inflammatory, and xanthine oxidase inhibitory activities of ginger extracts and its reference compounds. Ind. Crop. Prod. 2015;70: 238–244.
10. Sugiarti, B.A.D., Februyani, N., Saputri, R.K. Uji Antioksidan Sediaan Suspensi Ekstrak Sereh Dapur (Cymbopogon Citratus) dengan Variasi Konsentrasi Suspending Agen PGA (Pulvis Gummi Arabici) dan CMC – NA.. Indonesian Journal of Health Science. 2023; 3 (2): 257 – 262
11. Katsukawa M, Nakata R, Takizawa Y, Hori K, Takahashi S, Inoue H. Citral, a component of lemongrass oil, activates PPARα and γ and suppresses COX-2 expression. Biochim Biophys Acta. 2010;1801(11):1214-20.
12. Maisyah, A, Khiong, T.K, Jafar, G. Penentuan Aktivitas antioksidan dari 3 Jenis Simplisia Jahe (Gajah, Emprit, Merah) Untuk pengobatan Tradisional Chinese medicine (TCM). Majalah Farmasetika. 2024: 9(3). 293-300
13. Panggabean A. Pemanfaatan Tumbuhan Serai Wangi (Cymbopogon nardus (L.) Rendle) Sebagai Antioksidan Alami. J. Kim. Mulawarman. 2013;10(2):74– 79
14. Wresdiyati, T., Astawan, M., Adnyane, I.K.M. Aktivitas Antiinflamasi Oleoresin Jahe (Zingiber officinale) pada Ginjal Tikus yang mengalami Perlakuan Stress. Jurnal Teknologi dan Industri Pangan. 2017; 14(2):113-120
15. Sari, D., Nasuha, A. Kandungan Zat Gizi, Fitokimia dan Aktivitas Farmakologis Pada Jahe (Zingiber Officinale rosc) : Review. Tropical BioScience : Journal of Biological Science.2021; 1(2):11-18
16. Said, A.M., Atwa, S.A.E., Khalifa, O.A. Ameliorating effect of gum arabic and lemongrass on chronic kidney disease induced experimentally in rats. Bulletin of the National Research Centre. 2019; 43:47: 1-8
17. Mukarram, M., Chudhary, S., Khan, M.A., et al. Lemongrass Essential Oil Components with Antimicrobial and Anticancer Activities. Antioxidants. 2022; 11:20. . https://doi.org/10.3390/antiox11010020