

The potential of kawa leaf coffee in reducing oxidative stress after physical exercise

El potencial del café de hoja de kawa para reducir el estrés oxidativo después del ejercicio físico

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Abstract. The aim of this study was to analyze the effect of kawa leaf coffee drinks in reducing oxidative stress after physical exercise. This research is a pre-experiment with a one group pretest-post-test design. A total of 10 pentanque athletes aged between 18-22 years (male; $n_1=6$ and female; $n_2=4$) participated voluntarily. The research procedure includes taking blood samples as pretest and post-test data to analyze levels of Hemoglobin (Hb), Leukocytes, Malondialdehyde (MDA) and Interleukin-6 (IL-6). Participants run 400 m and rested for 10-15 minutes, then were given kawa leaf coffee which had been soaked in boiling hot water for five minutes. The results of the study showed that analysis of the antioxidant activity of kawa leaf coffee drinks that were soaked in boiling water for 5 minutes had the best oxidant activity (6936.58 ppm with 6.93%). This drink has an effective influence on oxidative stress levels, and there is no significant potential as a balancer for Hb, Leukocytes, MDA, and IL-6 ($p>0.05$). In conclusion, kawa leaf coffee can be used as an alternative drink for athletes and non-athletes to minimize spikes in MDA as a marker of oxidative stress after physical exercise.

Keywords: physical exercise, oxidative stress, kawa leaf coffee

Resumen. El objetivo de este estudio fue analizar el efecto de las bebidas de café de hoja de kawa en la reducción del estrés oxidativo tras el ejercicio físico. Esta investigación es un pre-experimento con un diseño de prueba previa y posterior a un grupo. Un total de 10 deportistas de pentanca con edades comprendidas entre 18 y 22 años (hombres; $n_1=6$ y mujeres; $n_2=4$). El procedimiento de investigación incluye la toma de muestras de sangre como datos previos y posteriores a la prueba para analizar los niveles de Hemoglobina (Hb), Leucocitos, Malondialdehído (MDA) e Interleucina-6 (IL-6). Los participantes corrieron 400 m y descansaron durante 10 a 15 minutos, luego se les dio café de hoja de kawa remojado en agua hirviendo durante cinco minutos. Los resultados del estudio mostraron que el análisis de la actividad antioxidante de las bebidas de café de hoja de kawa que se remojaron en agua hirviendo durante 5 minutos tuvieron la mejor actividad oxidante (6936.58 ppm con 6.93%). Esta bebida tiene una influencia efectiva sobre los niveles de estrés oxidativo, y no existe un potencial significativo como equilibrador de Hb, Leucocitos, MDA e IL-6 ($p>0,05$). En conclusión, el café de hoja de kawa se puede utilizar como bebida alternativa para deportistas y no deportistas para minimizar los picos de MDA como marcador de estrés oxidativo después del ejercicio físico.

Palabras Clave: ejercicio físico, estrés oxidativo, café de hoja kawa

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Introduction

Physical exercise cause metabolic changes that lead to the activation of adaptive mechanisms (Accattato et al., 2017). Regular physical activity and exercise have a positive impact on health and fitness (Antara et al., 2023; Firdaus et al., 2023; Handayani, Myori, Yulifri, Komaini, & Mario, 2023; Komaini et al., 2023; Umar, Alnedral, Ihsan, Mario, & Mardesia, 2023; Welis, Yendrizal, Darni, & Mario, 2023). However, intense activity can trigger an imbalance between antioxidants and Reactive Oxygen Species (ROS) (Monda et al., 2020; Pingitore et al., 2015). This condition, better known as oxidative stress, is related to muscle damage after exercise (Ayubi, Padmasari, et al., 2024; Kusuma et al., 2023).

The relationship between exercise and oxidative stress is complex and depends on the intensity and duration of exercise. This needs special attention, because it can cause various kinds of degenerative diseases such as heart disease (Raab, 2012), diabetes mellitus, stroke (Iyer, 2019) and cancer (Moreno-Ceballos, Arroyave, Cortes-Mancera, & Röthlisberger, 2019). In addition, degenerative diseases can also attack the spine (Li et al., 2019), adult knee joint (Lee, 2015), and cell damage (De Carvalho et al., 2022). Considering this fact, protection mechanisms are urgently

needed to overcome these problems (Flockhart et al., 2023).

Antioxidant supplementation to protect against muscle damage has been frequently discussed as a counter measure against excessive oxidative stress during exercise (Pingitore et al., 2015). However, many studies have shown that high doses of antioxidant supplementation can disrupt intrinsic adaptive responses and may negate the benefits of exercise (Paulsen et al., 2014). Additionally, the approximately 30 million people worldwide who experience pain are usually treated with nonsteroidal anti-inflammatory drugs (NSAIDs) (Kyriakidou, Wood, Ferrier, Dolci, & Elliott, 2021). This is the wrong action, because NSAIDs have an effect that interferes with the response to muscle growth (Schoenfeld, 2012). Therefore, a solution is needed by utilizing natural products such as the natural drink kawa leaf coffee. Coffee is a drink that has long been consumed by people in most regions in Indonesia. They not only consume coffee from the beans, but also consume the leaves, known as kawa leaf or kawa coffee (Rasyid, Sanjaya, & Zulharmita, 2017). Not surprisingly, kawa leaf coffee is used as a regional traditional drink (Tomlinson, 2019). The most widely cultivated coffee plant in Indonesia is *robusta* coffee (*coffea canephora*) (Shiyan, Herlina, Arsela, & Latifa, 2017). Coffee leaves contain many different phytochemicals that have health benefits

including anti-inflammatory, antioxidant, anti-diabetic, and controlling oxidative stress (Rasyid et al., 2017). Previous studies reported that administration of infused and ethanol extracts of robusta coffee leaves has anti-diabetic properties which can reduce blood glucose levels (Shiyan et al., 2017). In addition, coffee leaves are also used as a functional food to prevent metabolic syndrome with biochemical content (such as caffeine, flavonoids, chlorogenic acid, and mangiferin) (Chen, Ma, & Kitts, 2018).

Additional studies related to natural products such as honey have also been investigated to reduce oxidative stress after physical exercise (Kusuma et al., 2023). For example, a study from Kheirdeh et al investigated giving royal jelly with honey along with aerobic exercise against oxidative stress (Kheirdeh, Koushkie Jahromi, Brühl, & Brand, 2022), and the benefits of honey supplementation on lipid profile, inflammation, oxidative stress, mood, and satiety in overweight people (Petelin et al., 2019). Rosella flower polyphenolic compounds have also been investigated for their potential to reduce oxidative stress after physical exercise (Ayubi, Padmasari, et al., 2024). This is because the phytochemical components in rosella are believed to have strong antioxidant qualities and are able to prevent the negative effects of oxidative stress. Then, watermelon extract supplementation has also been investigated and is able to protect against oxidative stress (Ayubi, Syafawi, et al., 2024). To date, only a few studies have investigated how kawa leaf coffee drinks reduce oxidative stress caused by physical exercise and exercise, and consistent evidence from human studies is still rare.

This study aims to analyze the effect of kawa leaf coffee drinks in reducing oxidative stress after physical exercise. It is hoped that these findings can be used as an alternative drink for athletes to reduce oxidative stress after physical exercise.

Materials and Methods

This research is a pre-experiment with a one group pretest-post-test design. A total of 10 pentanque athletes in West Sumatra, Indonesia participated voluntarily in this study, who were recruited randomly. Participants were aged between 18-22 years, consisting of male ($n_1=6$) and

female ($n_2=4$) (see Table 1). The inclusion criteria for participants are: (a) doing regular exercise for at least six months, (b) participating voluntarily by signing a written consent, (c) not being sick or in the process of healing for the last month, (d) did not smoking, (e) did not drink alcohol, (f) did not consume antioxidant supplements in the last week, and (g) did not exercise for three days when the initial blood sample was taken. Meanwhile, the exclusion criteria for participants are: (a) being sick or injured, (b) unable to cooperate well, (c) not willing to take part in the entire research series, (d) BMI above 30 and less than 18, (e) have a hereditary history of stroke, (f) heart disease, (g) diabetes mellitus, and (h) cancer.

Testing of the effect of kawa leaf coffee drinks on oxidative stress was carried out in the sports medicine laboratory, Faculty of Sports Sciences, Universitas Negeri Padang. Making kawa leaf coffee includes various stages: (a) preparing 10 gr of fresh coffee leaves which have been roasted and soaked in 5 liters of boiling hot water for 5 minutes; (b) add 25 gr of ginger and 125 ml of liquid sugar while stirring continuously until the coffee soaking water is not too hot; and (c) the soaking water is filtered to separate the dregs of coffee leaves and ginger. Soaking coffee leaves for 5 minutes is based on the results of analysis of antioxidant activity in coffee leaves, with 6.93% and 6936.58 ppm (see Table 2).

This research procedure includes taking blood samples as pretest data. Participants run 400 m and were given 300 ml of kawa leaf coffee. Then, blood samples were taken to test Hb, Leukocyte, MDA and IL-6 levels after the participants rested for 10-15 minutes (post-test).

Data were analyzed using descriptive statistics to explain each characteristic of pretest and post-test data. Then, paired samples t-test to conclude the effectiveness of the treatment which is indicated by the average difference before and after treatment (Frey, 2023). All data in this study were analyzed using the IBM SPSS version 26.00 statistical program.

Results

Participant characteristics are presented in Table 1, and the results of analysis of antioxidant activity in boiled and soaked kawa leaf coffee samples are presented in Table 2.

Table 1.
Participant characteristics

N	Age (years)	Weight (kg)	Height (cm)	BMI	Fat	400m run (m/s)	Pulse		Blood pressure		Lactic acid	
							Recovery	Activity	Diastole	Systole	Pre	Post
1	20	62.8	162.0	23.6	23.1	1.19	99/61	130	75	120	4.00	3.10
2	20	54.0	163.5	20.2	14.9	1.13	99/66	97	70	120	3.60	2.80
3	21	48.1	158.0	19.2	19.0	1.36	99/83	144	80	120	4.60	2.40
4	21	60.6	162.0	23.0	22.7	1.14	99/61	97	70	120	3.00	1.80
5	20	58.2	152.0	25.1	31.8	1.58	99/68	128	70	110	2.90	1.90
6	21	80.7	172.0	25.2	27.1	1.11	99/78	120	80	130	3.50	1.10
7	22	77.8	169.0	27.2	29.9	1.17	99/70	99	70	110	3.40	1.10
8	21	61.6	166.0	22.3	25.9	1.52	99/84	160	70	110	4.10	1.00
9	21	60.0	162.0	22.7	27.3	1.24	99/54	120	75	120	3.30	3.60
10	18	69.4	168.5	24.4	23.5	1.10	99/91	136	75	120	3.00	1.00
\bar{x}	20.50	63.32	163.50	23.29	24.52	1.25	99/71.60	123.10	73.50	118.00	3.54	1.98
SD	1.08	10.08	5.80	2.39	5.03	0.17	11.94	21.08	4.12	6.32	0.55	0.96
Max	22	80.70	172.00	27.20	31.80	1.58	99/91	160.00	80.00	130.00	4.60	3.60
Min	18	48.10	152.00	19.20	14.90	1.10	99/54	97.00	70.00	110.00	2.90	1.00

Table 2.
Summary of results of analysis of antioxidant activity in coffee leaf samples

Coffee leaves	Duration (minutes)	Analysis results	Method
Boiled	5	2242.61 ppm (2.24%)	Spectrophotometer UV-VIS
	10	3258.23 ppm (3.25%)	
Soaked	5	6936.58 ppm (6.93%)	
	10	1284.31 ppm (1.28%)	

Note- Sample testing on coffee leaves is carried out in 100 gr.

The results of the analysis of antioxidant activity in kawa leaf coffee samples were carried out using two methods, namely coffee leaves that were boiled for five minutes (2242.61 ppm with 2.24%) and ten minutes (3258.23 ppm with 3.25%). Then, the coffee leaves were soaked for five minutes (6936.58 ppm with 6.93%) and ten minutes (1284.31 ppm with 1.28%). In other words, coffee leaves that were soaked for five minutes had the best percentage, namely 6.93% with 6936.58 ppm. The test results for Hb, Leukocytes, MDA and IL-6 parameters are presented in Table 3, and the results of statistical tests in Table 4.

Table 3.
Summary of test parameters for Hemoglobin, Leukocytes, Malondialdehyde and Interleukin-6

Source	Hematology (11-16 g/dl)		Leukocytes (4-10) 10 ³ /ul		MDA (nmol/ml)		IL-6 (pg/ml)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
\bar{x}	14.68	14.02	7.21	7.75	9.22	10.64	575.67	572.92
SD	2.10	1.22	1.70	1.70	1.85	2.43	701.57	700.45
Max	19.60	16.00	10.19	10.58	12.73	16.24	2256.62	2258.79
Min	11.16	12.00	5.07	5.67	6.15	6.54	28.93	47.00

Note- Hematology is (11-16 g/dL), Leukocytes is (4-10) 10³/ul, MDA is (nmol/ml), and IL-6 is (pg/ml).

Table 4.
Summary of paired samples t-test

Model	Unstandardized Coefficient		Standardized Coefficient Beta	t	P
	B	Std. Error			
Constant	15.341	0.988		15.521	0.000
Hb	-0.657	0.625	-0.195	-1.052	0.302
Constant	6.679	0.983		6.793	0.000
Leukosit	0.535	0.622	0.161	0.861	0.397
Constant	7.807	1.247		6.259	0.000
MDA	1.417	0.789	0.321	1.796	0.083
Constant	578.412	404.728		1.429	0.164
IL-6	-2.747	255.972	-0.002	-0.011	0.992

Note- Significance ($p < 0.05$).

Table 4 shows that: (a) there is no significant difference in Hb levels between before and after running 400 m and consuming kawa leaf coffee drinks ($p > 0.05$); (b) there is no significant potential of consuming kawa leaf coffee drinks to balance Leukocytes after running 400 m ($p > 0.05$); (c) there is no significant potential for consuming kawa leaf coffee drinks to balance high and low MDA after running 400 m ($p > 0.05$); and (d) there is no significant potential of consuming kawa leaf coffee drinks to balance IL-6 after running 400 m ($p > 0.05$).

Discussion

The aim of this study was to analyze the effect of kawa leaf coffee drinks in reducing oxidative stress after physical

exercise. The potential of kawa leaf coffee as a sports drink has an effective influence on oxidative stress levels, and there is no significant potential as a balancer for Hb, Leukocytes, MDA, and IL-6. Previous studies reported that consuming caffeinated instant coffee drinks with non-caffeinated antioxidants rich in antioxidants provided properties to reduce oxidative stress after strenuous exercise (Viana et al., 2012). In addition, according to Davis et al, coffee drinks that are rich in nutrients can delay fatigue factors in long-distance running athletes (Davis, Green, Laurent, Bacon, & Thomas, 2022). Another study also reported that coffee drinks are thought to cause a reduction in systemic oxidative DNA damage through decreasing iron stores in the body (Hori et al., 2014). Young coffee leaves with varieties of arabica and robusta have high total phenolic levels (Patil, Shankar, & Murthy, 2023). Welis et al reported, that coffea robusta has the potential to prevent post-exercise oxidative stress (Welis et al., 2022). Caffeine is an alkaloid compound in coffee, which increases insulin release from pancreatic β cells and improves glucose tolerance (Baspinar, Eskici, & Ozcelik, 2017). Flavonoids prevent insulin resistance and increase insulin sensitivity (Galleano et al., 2012), and mangiferin can improve insulin sensitivity and glucose tolerance (Fomenko & Chi, 2016).

Kawa coffee drinks contain a mixture of bioactives found in coffee leaves which have cell strengthening properties (Hasballah, Lestari, Listiawan, & Sofia, 2022). The flavonoids and all the phenols contained in the leaves are cancer-preventing agents that can kill the increase in oxidative stress that occurs during sports activities. Phenolic compounds are believed to be credited with strengthening cell movement through the instrument of redox properties, killing lipid-free extremists, and preventing hydroperoxide damage to free revolutionary (Defri, Palupi, Wahyudi, & Yuliana, 2022). Apart from flavonoids and phenols, the tannin content in robusta coffea leaves also has the potential to strengthen cells (Kaur, Tyagi, & Kundu, 2018). According to Przeliorz and Regulska, athletes who do intensive training must have the best way and can regularly arrange natural foods rich in antioxidants (for example fresh fruit, vegetables and tea) to increase the neutralization of an increase in ROS (Przeliorz & Regulska-Ilow, 2022). This research has been carried out as closely as possible to avoid errors during treatment. Although these findings are promising, this research still has weaknesses. This research involved 10 pentanque athletes in West Sumatra, Indonesia who carried out a 400 m running test before being given a brewed kawa leaf coffee drink. In addition, there is no control group to compare the results of this treatment. Future research is needed for this.

Conclusions

The conclusion of this research is that the analysis of the antioxidant activity of kawa leaf coffee drinks that are boiled for 5 and 10 minutes is 2.24% and 3.25%. Meanwhile, the antioxidant activity of kawa leaf coffee soaked for 5 and 10

minutes was 6.93% and 1.28%. This means that the best antioxidant activity for kawa leaf coffee is soaking in boiling water for 5 minutes. Overall, this kawa leaf coffee drink has great potential as a sports drink that is rich in antioxidants to prevent oxidative stress, and has no significant potential as a balancer for Hb, Leukocytes, MDA, and IL-6 in athletes. Oxidative stress needs special attention through the provision of natural drinks rich in antioxidants such as the kawa leaf coffee drink in these findings. Kawa leaf coffee drinks can minimize the spike in MDA as a marker of oxidative stress after physical exercise, so it can be used as an alternative drink for athletes and non-athletes. A broader participant and comparison group is needed for future research.

Conflict of interest

The authors report no potential conflicts of interest.

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