

Variances in the effect of caffeine in arabica coffee and robusta towards the aerobic endurance and the heart rate of football players from persatuan sepak bola condong catur FC (PSCC FC)

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Abstract

This research seeks to ascertain the variances in the effects of caffeine from Arabica and Robusta coffee on endurance and the heart rate. This research was a descriptive comparative study with 45 samples, utilizing a complete sampling technique followed by random sampling to categorize them into three groups. The data collecting method involved the measurement of the resting heart rate, post-bleep test, recovery, and during the bleep test. An independent sample t-test was employed to examine the differences in VO₂max values and heart rates between Arabica and Robusta coffee. The research findings indicate substantial variations in the endurance capabilities of the Arabica and Robusta groups, with a computed t-value of 8.335 exceeding the t-table value of 2.048, and a significance level of 0.000, which is less than 0.05. The disparity in the bleep test results between the Arabica and Robusta groups is at 6.613. The resting pulse rates of the Arabica and Robusta groups show no significant difference, with t values of pulse 0 at -0.277, pulse 1 at -1.248, pulse 2 at -1.430, and pulse 3 at -0.929, compared to a t table value of 2.048. The significance values are 0.784, 0.223, 0.164, and 0.361. 0.05 The recovery pulse rate of the Arabica and Robusta groups show no significant difference, with a t count of -0.929 (t table 2.048) and a significance value of 0.361. 0.05 The disparity in the bleep test results between the Arabica and Robusta groups is at 2.933. The recovery pulse of the Arabica and Robusta groups show no significant difference, with a t value of 1.910 for pulse 5 and 0.624 for pulse 6, compared to a t table value of 2.048. Has a significance value of 0.066, 0.538 > 0.05. Arabica coffee enhances endurance more markedly than Robusta coffee. Robusta coffee can elevate resting heart rate and heart rate following a bleep test. Robusta coffee might also expedite the recovery pulse more than Arabica coffee.

Keywords: coffee, endurance, heart rate

INTRODUCTION

Sport is a physical activity performed regularly and in a planned manner to improve physical and mental fitness. The goal of sport is to maintain and improve a person's fitness, performance, quality of life, and health. The development of sport has been extremely beneficial for human survival to this day. Furthermore, sport also provides significant opportunities for enhancing the nation's capacity to implement sustainable development systems. Many sports can be played, for example, soccer.

Football is one of the most popular sports in the world, even in Indonesia. This is evident in the frequency and familiarity with it, enjoyed by everyone from children to adults, the elderly, and even men and women. Football itself is a team sport, with each team consisting of eleven players. It is played with the feet, except for the goalkeeper, who may use his hands. The goal of football is to score as many goals as possible against the opponent and to prevent conceding goals. Furthermore, football is a complex sport, meaning that players must possess many components, including technique, tactics, physical fitness, and mental aptitude.

Physical fitness is one of the foundations of football, supporting the development of technical, tactical, and mental components. According to Grosser in Syafruddin (2016:54), "The physical conditions required for sports include: (1) endurance, (2) speed, (3) flexibility, and (4) strength," as quoted by (Sepriani & Rahman, 2019). Considering the characteristics of soccer, which requires extensive movement over a long period of time, a game is played over two 45-minute periods. One of the factors that determines an athlete's success in soccer is aerobic endurance, without compromising other physical aspects.

Aerobic endurance is one of the parameters used to assess an athlete's physical fitness. Aerobic endurance is the body's ability to perform activities for extended periods without fatigue. Aerobic endurance can also be defined as the ability to contract muscles continuously for an extended period of time under a specific load. Aerobic endurance is a person's ability to sustain a training load for a prolonged period of time. Aerobic endurance can be measured by measuring the maximum oxygen volume (VO₂max). VO₂max is the body's maximum capacity to take in, transfer, and use oxygen during exercise. VO₂max results reflect the maximum oxygen transport from muscles to mitochondria to produce energy. The higher the VO₂max results achieved by an athlete, the greater their endurance, allowing them to perform more vigorous physical activities than athletes with lower endurance. Furthermore, VO₂max is also an endurance parameter that can be used to assess aerobic fatigue (Verducci and Warren, 2000).

VO₂max can be measured in several ways, such as the beep test, the Balke test, the Cooper test, the 12-minute run, and many more. The beep test is a suitable test for assessing endurance and fitness for endurance and group sports like soccer. Soccer is a game that requires both aerobic and anaerobic endurance. Soccer matches last 2 x 45 minutes, thus requiring strong endurance. Players who lack endurance are at risk of fatigue during matches and training, thus reducing maximum performance.

During intensive exercise, the body experiences fatigue. To overcome this, many athletes use energy supplements before exercise to boost their energy. These supplements contain harmful chemicals that are dangerous if consumed long-term. Some athletes have a habit of drinking coffee before exercise to improve performance and prevent muscle fatigue (Umat, 2010). Many people replace coffee as an alternative to increase energy and relieve fatigue.

The caffeine content in coffee helps strengthen the body, maintain overall fitness, and reduce the risk of injury during exercise. However, according to the International Olympic Committee or the National Collegiate Athletic Association (NCAA), the maximum caffeine limit in an athlete's urine should not exceed 12 micrograms/ml of urine, and according to the National Collegiate Athletic Association (NCAA), the maximum caffeine limit in urine should not exceed 15 micrograms/ml of urine (Rudy, 2009). Caffeine also stimulates energy in heart cells, resulting in increased cardiac energy. Heart energy influences the strength of the heart's pumping pressure and frequency, automatically triggering an increased heart rate. VO₂max is known to be influenced by maximal cardiac output, lung function, body composition, and consumption of caffeinated beverages such as coffee (Febriani, Pradana, & Manggabarani, 2021).

Coffee comes from plants and is essentially a fruit seed. In scientific nomenclature, the coffee plant belongs to the genus *Coffea*. Coffee enthusiasts continue to research and discover new species, resulting in the continued development of scientific classifications related to coffee. The exact number of species is uncertain, though it is said to number in the hundreds. Generally, only *Coffea arabica* and *Coffea canephora* (robusta) are widely grown on plantations worldwide as cultivated crops. Robusta has a superior caffeine content to Arabica. Arabica coffee contains 0.8-1.4 percent caffeine, while Robusta can contain 1.7-4 percent (Edison W., 2019).

Caffeine can increase endurance and heart rate, which are crucial in sports like soccer. Previous research has shown that caffeine can improve training and match performance, although it has become increasingly popular in sports to enhance muscle performance (Nandatama, 2016). However, several studies have shown that consuming caffeine before training significantly increases the endurance of soccer players (Ashabul, 2020). Therefore, caffeine can be an effective supplement for improving endurance and heart rate in soccer, but its use must be carefully monitored to avoid unwanted side effects.

The Condong Catur Football Association (PSCC) is a local football team in Sleman Regency. This football club is coached by a National PSSI C-licensed coach and is populated by players who have

participated in official PSSI competitions. PSCC itself is a local team that aims to develop and accommodate football talent in Sleman Regency. The main manager of the PSCC team is Wahyu Nurendra and the main coach of the PSCC team is Ahmad Rizal Riyadi. PSCC is also a member of the ASKAB PSSI Sleman Regency. It also participates in the ASKAB Sleman League and is included in the ASKAB Sleman League Main Division.

Researchers conducted observations during PSCC training. During the observations, the players were found to be in good physical condition, particularly in aerobic endurance. However, there is no definitive value for the players' aerobic endurance, as there was no baseline parameter test. Players' physical condition needs to be improved, as seen mid-game when negative transitions were less effective due to late defensive play, decreased intensity, and decreased support after passing. Several training methods have been implemented to improve player endurance. However, the method involving caffeine in coffee has not been used by coaches.

Based on the above description, the researchers were interested in further examining the effect of caffeine on endurance. They also wanted to understand the differences between Arabica and Robusta coffee. Therefore, the researchers wrote a study entitled "The Difference in Caffeine Administration of Arabica and Robusta Coffee on the Aerobic Endurance of Football Players of the Condong Catur FC Football Association (PSCC)."

METHOD

The research entitled "The Difference in Caffeine Administration of Arabica Coffee and Robusta Coffee on the Endurance and Pulse Rate of Football Players of the Condong Catur Football Association (PSCC)" is a comparative descriptive research, namely a research method used to compare the existence of one or more variables in two or more different samples or at different times (Sugiyono, Quantitative, Qualitative and R & D Research Methods, 2011). This study sought the difference in caffeine administration of Arabica coffee and Robusta coffee on the endurance and pulse rate of football players of the Condong Catur Football Association (PSCC) using a survey method. Subjects were divided into three groups, one group received treatment with Arabica coffee, the second group received treatment with Robusta coffee and the other group received treatment without giving Arabica and Robusta coffee. Each group underwent tests and measurements.

The time used by researchers for this research was carried out on December 20, 2024 and December 31, 2024, namely for data collection. This research was conducted at Ganjuran Field located on Jl. Gambir Anom, Manukan, Condong Catur, Depok district, Sleman regency. The research was carried out at the Condong Catur Football Association (PSCC). Population is a generalization area consisting of objects or subjects that have certain qualities and characteristics determined by the research to be studied and then conclusions drawn (Sugiyono, Quantitative, Qualitative and R&D Research Methods, 2011). This study used a population with all 45 players of the Condong Catur Football Association (PSCC). After the population size was known, the next step was to determine the sample or object to be studied. The sample in this study was taken based on the total sampling technique, then random sampling was carried out to divide it into 3 groups with 15 people in the control group (without giving Arabica coffee and Robusta coffee), 15 people in the Arabica group, and 15 people in the Robusta group.

This study has two variables, namely the administration of caffeine in Arabica coffee and Robusta coffee as independent variables and endurance and pulse rate as dependent variables. The definition of variables in this study is as follows: Administration of caffeine in Arabica coffee is one method of providing an energy booster by administering caffeine through Arabica coffee to players before training. Administration of caffeine in Robusta coffee is one method of providing an energy booster by administering caffeine through Robusta coffee to players before training. Endurance is the body's ability to perform physical activity for a long period of time without experiencing significant fatigue. In this study, endurance was measured with a bleep test. Pulse is a wave that is felt in the arteries when blood is pumped out of the heart. Pulse rates have three types: basal pulse rate, resting pulse rate, and exercise pulse rate.

RESULTS AND DISCUSSION

This study was conducted on December 20, 2024 and December 31, 2024 at the Ganjuran Condong Catur field. The subjects of this study were 45 PSCC soccer players. Subjects were selected based on the provisions, namely, registered PSCC soccer players and subjects who were willing to take tests and measurements. This study aims to find differences in the increase in drinking Arabica and Robusta coffee on endurance and heart rate. Each athlete will have their heart rate measured 7 times: resting heart rate, resting heart rate (5, 15, and 30 minutes) after without and with drinking coffee, heart rate after the bleep test, recovery heart rate (10 and 15 minutes after the bleep test. Tests and measurements were carried out in three groups, namely: the Robusta group, Arabica, and the water group.

Table 1. Number of research subjects

Group	Result
Robusta	15 People
Arabica	15 People
White Water	15 People
Total	45 People

The table above shows the number of research subjects, consisting of 45 people, divided into three groups: the Robusta group, the Arabica group, and the plain water group.

1. Arabica Group

The group data description is based on the initial and final tests. The results are presented below.

a. Pre-test

The results of the data were analyzed descriptively using SPSS 26. The following are the output results from SPSS 26.

Table 2. Data Description Arabica Group

	N	Minimum	Maximum	Mean	Std Deviation
Bleep Tes	15	40,5	47,4	44,607	2,1049
Pulse 0	15	60	84	74,53	6,947
Pulse 1	15	64	88	76,93	6,881
Pulse 2	15	64	92	80,27	7,166
Pulse 3	15	64	100	86,93	10,194
Pulse 4	15	132	192	160,80	13,873
Pulse 5	15	6	104	82,67	11,381
Pulse 6	15	60	88	74,67	6,705
ValidN(liswise)	15				

Based on the results of SPSS 26, it can be seen that the Minimum Bleep Test value is 40.5, Pulse 0 is 60, Pulse 1 is 64, Pulse 2 is 64, Pulse 3 is 64, Pulse 4 is 132, Pulse 5 is 60, Pulse 6 is 60. The maximum Bleep Test value is 47.4, Pulse 0 is 84, Pulse 1 is 88, Pulse 2 is 92, Pulse 3 is 100, Pulse 4 is 192, Pulse 5 is 104, Pulse 6 is 88. The Mean Bleep Test value is 44.607, Pulse 0 is 74.53, Pulse 1 is 76.93, Pulse 2 is 80.27, Pulse 3 is 86.93, Pulse 4 is 160.80, Pulse 5 is 82.67, DN6 is 74.67. And the Standard Deviation value of Bleep Test is 2.1049, Pulse 0 is 6.947, Pulse 1 is 6.881, Pulse 2 is 7.166, Pulse 3 is 10.194, Pulse 4 is 13.873, Pulse 5 is 11.381, Pulse 6 is 6.705.

b. Post-test

The results of the data were analyzed descriptively using SPSS 26. The following are the output results from SPSS 26.

Table. 3. Data Description Arabica Group

	N	Minimum	Maximum	Mean	Std Deviation
Bleep Tes	15	42,9	53,1	46,140	2,6989
Pulse 0	15	64	132	79,87	19,690
Pulse 1	15	60	90	77,73	8,172
Pulse 2	15	64	96	77,33	9,155
Pulse 3	15	72	100	82,67	8,095
Pulse 4	15	136	172	157,60	10,006
Pulse 5	15	68	104	90,40	10,881
Pulse 6	15	64	88	76,27	7,324
ValidN(liswise)	15				

Based on the results of SPSS 26, it can be seen that the Minimum Bleep Test value is 42.9, Pulse 0 is 64, Pulse 1 is 60, Pulse 2 is 64, Pulse 3 is 72, Pulse 4 is 136, Pulse 5 is 68, Pulse 6 is 64. The maximum Bleep Test value is 53.1, Pulse 0 is 132, Pulse 1 is 90, Pulse 2 is 96, Pulse 3 is 100, Pulse 4 is 172, Pulse 5 is 104, Pulse 6 is 88. The Mean Bleep Test value is 46.140, Pulse 0 is 79.87, Pulse Pulse 1 is 77.73, Pulse 2 is 77.33, Pulse 3 is 82.67, Pulse 4 is 157.60, Pulse 5 is 90.40, Pulse 6 is 76.27. And the Standard Deviation value of Bleep Test is 2.6989, Pulse 0 is 18.690, Pulse 1 is 8.172, Pulse 2 is 9.155, Pulse 3 is 8.095, Pulse 4 is 10.006, Pulse 5 is 10.881, Pulse 6 is 7.324.

2. Robusta Group

a. Pre-test

The results of the data were analyzed descriptively using SPSS 26. The following are the output results from SPSS 26.

Table. 4. Data Description Robusta Group

	N	Minimum	Maximum	Mean	Std Deviation
Bleep Tes	15	33,6	39,6	37,327	1,7669
Pulse 0	15	64	156	88,67	29,488
Pulse 1	15	68	108	81,60	10,907
Pulse 2	15	68	88	78,93	5,750
Pulse 3	15	72	100	81,33	9,641
Pulse 4	15	132	168	152,40	8,822
Pulse 5	15	68	96	83,73	9,130
Pulse 6	15	68	88	77,60	6,197
ValidN(liswise)	15				

Based on the results of SPSS 26, it can be seen that the Minimum Bleep Test value is 33.6, Pulse 0 is 64, Pulse 1 is 68, Pulse 2 is 68, Pulse 3 is 72, Pulse 4 is 132, Pulse 5 is 68, Pulse 6 is 68. The maximum Bleep Test value is 39.6, Pulse 0 is 156, Pulse 1 is 108, Pulse 2 is 88, Pulse 3 is 100, Pulse 4 is 168, Pulse 5 is 96, Pulse 6 is 88. The Mean Bleep Test value is 37.327, Pulse 0 is 88.67, Pulse Pulse 1 is 81.60, Pulse 2 is 78.93, Pulse 3 is 81.33, Pulse 4 is 152.40, Pulse 5 is 83.73, Pulse 6 is 77.60. And the Standard Deviation value of Bleep Test is 1.7669, Pulse 0 is 29.488, DN1 is 10.907, Pulse 2 is 5.750, Pulse 3 is 9.641, Pulse 4 is 8.822, Pulse 5 is 9.130, Pulse 6 is 6.197.

3. Control Group

a. Pre-test

The results of the data were analyzed descriptively using SPSS 26. The following are the output results from SPSS 26.

Table. 5. Data Description Robusta Group

	N	Minimum	Maximum	Mean	Std Deviation
Bleep Tes	15	27,2	33,6	31,093	1,7351
Pulse 0	15	64	84	73,87	6,739
Pulse 1	15	72	92	81,60	4,968
Pulse 2	15	80	92	84,80	3,448
Pulse 3	15	88	100	92,53	3,335
Pulse 4	15	132	174	157,87	12,682
Pulse 5	15	60	96	82,40	11,089
Pulse 6	15	64	84	74,67	6,705
ValidN(liswise)	15				

Based on the results of SPSS 26, it can be seen that the Minimum Bleep Test value is 27.2, Pulse 0 is 64, Pulse 1 is 72, Pulse 2 is 80, Pulse 3 is 88, Pulse 4 is 132, Pulse 5 is 60, Pulse 6 is 64. The maximum Bleep Test value is 33.6, Pulse 0 is 84, Pulse 1 is 92, Pulse 2 is 92, Pulse 3 is 100, Pulse 4 is 174, Pulse 5 is 96, Pulse 6 is 84. The Mean Bleep Test value is 31.093, DN0 is 73.87, DN1 is 81.60, Pulse 2 is 84.80, Pulse 3 is 92.53, Pulse 4 is 157.87, DN5 is 82.40, Pulse 6 is 74.67. And the Standard Deviation value of Bleep Test is 1.7351, Pulse 0 is 6.739, Pulse 1 is 4.968, Pulse 2 is 3.448, Pulse 3 is 3.335, Pulse 4 is 12.682, Pulse 5 is 11.089, Pulse 6 is 6.705.

b. Post-test

The results of the data were analyzed descriptively using SPSS 26. The following are the output results from SPSS 26.

Table. 6. Data Description Robusta Group

	N	Minimum	Maximum	Mean	Std Deviation
Bleep Tes	15	26,4	35,4	30,253	2,7472
Pulse 0	15	64	156	93,87	34,670
Pulse 1	15	64	126	81,33	16,189
Pulse 2	15	64	88	78,13	7,386
Pulse 3	15	64	84	75,20	6,625
Pulse 4	15	144	164	154,13	6,002
Pulse 5	15	80	100	90,93	4,891
Pulse 6	15	64	88	77,07	5,750
ValidN(liswise)	15				

Based on the results of SPSS 26, it can be seen that the Minimum Bleep Test value is 26.4, Pulse 0 is 64, Pulse 1 is 64, Pulse 2 is 64, Pulse 3 is 64, Pulse 4 is 144, Pulse 5 is 80, Pulse 6 is 64. The maximum Bleep Test value is 35.4, Pulse 0 is 156, Pulse 1 is 126, Pulse 2 is 88, Pulse 3 is 84, Pulse 4 is 164, Pulse 5 is 100, Pulse 6 is 88. The Mean Bleep Test value is 30.253, Pulse 0 is 93.87, Pulse Pulse 1 is 81.33, Pulse 2 is 78.13, Pulse 3 is 75.20, Pulse 4 is 154.13, Pulse 5 is 90.93, Pulse 6 is 77.07. And

the Standard Deviation value of Bleep Test is 2.7472, Pulse 0 is 34.670, Pulse 1 is 16.189, Pulse 2 is 7.386, Pulse 3 is 6.625, Pulse 4 is 6.022, Pulse 5 is 4.891, Pulse 6 is 5.750.

DISCUSSION

The caffeine content in coffee helps strengthen the body, maintain overall fitness, and reduce the risk of injury during exercise. However, caffeine consumption should not exceed 400 milligrams per day. Caffeine also stimulates energy in heart cells, resulting in increased heart energy. Heart energy influences the strength of the heart's pumping pressure and frequency, automatically triggering an increased heart rate. $VO_2\max$ values are known to be influenced by maximal cardiac output, lung function, body composition, and consumption of caffeinated beverages such as coffee (Febriani, Pradana, & Manggabarani, 2021).

This study aimed to determine the difference in caffeine intake from Arabica and Robusta coffee on the endurance and heart rate of soccer players from the Condong Catur FC Football Association (PSCC). Based on the research data from the tests conducted, the following explanation can be given:

The average endurance capacity of the Arabica group was 46.1, while the Robusta group had an average of 39.5. The endurance capabilities of the Arabica and Robusta groups showed a significant difference, with a calculated t of $8.335 > t$ table 2.048, and a significance value of $0.000 < 0.05$. The difference in the bleep test between the Arabica and Robusta groups was 6.613. Where the one that provided a more significant increase was Arabica coffee. Endurance is endurance can also be understood as endurance time, namely a person doing high or intensive activities for a long period of time without feeling tired. Endurance is always related to the duration and intensity of training or activity. The longer and more intense an athlete's training time, the greater their endurance.

The Arabica group's resting heart rate averaged 79.8, 77.7, and 81.3, while the Robusta group's averaged 82.1, 81.2, and 81.3. There was no significant difference between the Arabica and Robusta groups' resting heart rates, with a calculated t -value of -0.277 for pulse 0, -1.248 for pulse 1, -1.430 for pulse 2, and -0.929 for pulse 3 ($< t$ -table 2.048). Significance values were 0.784, 0.223, 0.164, and 0.361 > 0.05 . Robusta coffee provided the most significant improvement.

The Arabica group's post-bleep test pulse rate averaged 82.6, while the Robusta group's average was 85.6. The recovery pulses of the Arabica and Robusta groups did not show a significant difference, with a calculated t -value of $-0.929 < t$ -table 2.048, and a significance value of $0.361 > 0.05$. Robusta coffee provided a more significant recovery. The difference in the bleep test between the Arabica and Robusta groups was 2.933, with Robusta coffee providing a higher increase.

The recovery pulses of the Arabica group had averages of 157.6, 90.4, and 76.2, while the Robusta group had averages of 82.9, 82.9, and 74.6. The recovery pulses of the Arabica and Robusta groups did not show a significant difference, with a calculated t -value of 1.910 for pulse 5 and 0.624 for pulse 6, respectively, $< t$ -table 2.048, and a significance value of 0.066, $0.538 > 0.05$. Robusta coffee provides faster recovery. The pulse is a wave felt in the arteries caused by the heart pumping blood through the blood vessels. Pulse rates are divided into three types (My B, 2005): 1) basal pulse rate, the pulse rate upon waking before activity; 2) resting pulse rate, the pulse rate when resting or relaxing without activity; 3) exercise pulse rate, the pulse rate during work or physical activity.

Based on the research results, it can be concluded that Arabica coffee can significantly increase endurance capacity than Robusta coffee. Robusta coffee can increase resting pulse rate and pulse rate after a bleep test. Robusta coffee can also accelerate the recovery pulse rate compared to Arabica coffee.

CONCLUSION

Based on the research results, it can be concluded that the differences in the administration of Arabica and Robusta coffee caffeine on endurance and pulse are as follows: There is a significant difference in the administration of Arabica and Robusta coffee. Where Arabica coffee can increase the endurance of soccer players more than Robusta coffee. There is no significant difference in the administration of Arabica and Robusta coffee in increasing resting pulse rate. However, Robusta coffee significantly increases resting pulse rate more than Arabica coffee. There is no significant difference in the administration of Arabica and Robusta coffee in increasing pulse rate after the bleep test. However, Robusta coffee significantly increases resting pulse rate more than Arabica coffee. There is no

significant difference in the administration of Arabica and Robusta coffee in pulse recovery. However, Robusta coffee is faster in pulse recovery than Arabica coffee.

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