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How to Safely Drink Your Coffee: An Observational Study of Coffee Serving Temperatures and Scald Risk Considerations

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ABSTRACT

Introduction: With burn injuries being a global public health burden, and coffee's increasing popularity in Indonesia and globally, the study investigating the standard brewing temperatures for coffee and the potential risks posed by higher serving temperatures is needed.

Method: We conducted an observational, prospective design study to investigate the temperature at which hot coffee drinks were served to consumers at various coffee outlets in Cirebon, West Java. We measured the initial temperature of the hot coffee at the time of serving and recorded the duration it took for the coffee to reach a milder and recommended safe temperature. We collected data from multiple coffee outlets and determined the average temperature of the served coffee. The study aimed to establish a benchmark for safe serving temperatures, later allowing consumers to enjoy their coffee immediately without risking scald injuries.

Results: The average serving temperature of coffee lattes was 54.1°C. While 80% of coffee outlets adhered to safe serving temperatures (60°C or lower), a significant number still served hotter coffee, putting consumers at risk of scalding injuries.

Discussion: The standard holding temperature for coffee recommended by the Coffee Brewing Center and the Nordic Coffee Center ranges from 80°C to 85°C (175°F to 185°F). However, serving temperatures can exceed this range and pose a risk of scald burns. Extensive research indicates that spills at higher temperatures, up to 82°C (up to 180°F), can cause serious burns. Children and the elderly are particularly vulnerable due to their thinner skin and slower reflexes. The study found that the average serving temperature of coffee lattes in paper cups was 54.1°C, within the safe threshold for immediate consumption. However, some coffee outlets served hotter coffee, putting customers at risk of scalding injuries. It was also observed that coffee makers and drinkers in tropical countries prefer milder temperatures compared to colder regions.

Conclusion: Hot coffee consumption can lead to burn injuries, especially scalds, which are a significant public health concern. Although recommended brewing and serving temperatures are higher, they pose a scald risk, particularly for vulnerable groups like children and the elderly. In Cirebon, West Java, the average serving temperature of coffee lattes in paper cups is safe at 54.1°C. However, some coffee outlets serve hotter coffee, endangering customers. To reduce scald burns, coffee outlets should adhere to safe temperatures and educate consumers on cooling time. Safer coffee practices can enhance overall safety and enjoyment of this popular beverage.

KEYWORDS: Scald, burn, coffee, brewing temperature, serving temperatures, safety considerations

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INTRODUCTION

Burn injury happens due to unintentional exposure to high-temperature substances, including hot liquid, solids, and objects radiating heat energy.[1] This places a high burden on patients' families and national healthcare systems globally.[2] Although burn injury occasions are gradually decreasing in well-deceloped countries, the prevalence remains high elsewhere, with upto 90% of burns occurring in low- and

middle-income areas.[3] The World Health Organization (WHO) estimates that 11 million burn injuries occur annually worldwide, 180,000 of which are fatal.[3,4] The American Burn Association (ABA) National Burn Repository 2019 reported that, overall, flame burns are still the majority of injuries in the USA (41%), with scalds ranked second at 31%.[3] Socioeconomic development in different countries continuously affects every aspect of life[5]. It is not surprising that burn injuries are also more common in populations with lower socioeconomic status and delayed developmental growth, e.g. a lack of primary safety education has been associated with increased risk for burn injuries.[5] Furthermore, the majority of burn injuries are preventable. When applied, educational programs, introducing smoke alarms/detectors, and controlling hot water in households have significantly decreased burn incidence rates and severity.[5]

Indonesia is the world's fourth-largest coffee producer and exporter in the world.[6] Indonesia's domestic coffee consumption has almost quadrupled since 1990, reaching the equivalent of 4.8 million 60-kilogram bags in 2019-2020[7]. In recent years, coffee has increased in popularity, fuelled by the global rise of café culture, the changing consumption patterns of the younger generation switching from tea to coffee, and a newfound appreciation for locally-produced coffee.[6,7]

Brewing theory stated that the temperature of the water used in brewing coffee should minimally be 85ºC (185ºF) and maximally 95ºC (203ºF) to obtain the ideal extraction,[8] then, the coffee should ideally be consumed shortly after a three-minute ripening period to improve the quality of brewed coffee as the flavour gradually loss occurs thereafter[8]. However, the above temperature is considered potentially dangerous in term of burn pathophysiology, particularly for the very young, or for people with imbalance disorders like the intoxicated individuals, or ones with altered mentation or behavior.[8] It appears that the temperatures specified as recommended by the hospitality and food science literature for brewing and holding coffee are at odds with the medical literature's discussion of beverage temperatures that result in a burn, permanent cellular damage, and death,[8] and the fact that 85-90% of scalds are related to cooking/drinking/serving hot liquids provides the evidence.[9] As coffee is regularly served at 175°F / 79°C, such serving temperature clearly is a high-risk for severe scald burns when spilled or accidentally pulled down.[10]

We set this study to establish a reference for people on how to safely and properly drink coffee for recreational purpose with recommended temperature consideration.

MATERIAL AND METHODS

Authors conducted an observational with prospective design study with subjects of hot coffee drinks served in a paper cup from several coffee brand outlets in Cirebon, West Java, to determine at what temperature the hot coffee delivered and served for consumers. Authors selected coffee lattes with consideration that younger people are not familiar with ordering coffee without foamed milk and latte variants are the most commonly ordered products.

Authors measured the temperature of hot coffee at the beginning of the serving and the time duration until the coffee temperature reached milder and recommended safe temperature. We placed a double thermometer directly inside the coffee after the serving, and recorded the duration of the temperature using a stopwatch. We collected the serving temperatures and set the average temperature of served coffee as a benchmark for hot coffee served by coffee outlets in Cirebon, which can be drunk immediately to avoid scald injury.

RESULTS

Authors collected data from 50 coffee outlets in Cirebon that provide take away coffee lattes in paper cups. Almost all of the 50 coffee outlets we visited provide hot caution to the lids of their paper cups to help consumers to be more cautious.

Our observation found that the serving temperature of the coffee latte in paper cups varied from 40ºC to 81ºC, and we discovered the average temperature of the served coffee latte was at 54.1ºC, which is actually within safe temperature in term of burn trigger pathophysiology. We also reckoned the mean time duration needed from the serving temperature to safe temperature for drinking was a minute and 48 seconds.

Despite 80% of coffee outlets serving hot coffee latte which can be safely consumed as soon as being served, however, there are still 10 coffee outlets that served hotter coffee latte than our temperature of safety recommendation 60ºC (see **Table 1**). From these 10 outlets, the average waiting time was obtained before a cup of coffee latte can be consumed at a minimum temperature that can be tolerated at 60ºC for approximately 8 minutes.

Table 1. Coffee Latte Temperature from Several Coffee Outlets In Cirebon

	Name of Coffee Shop	Serving temp.	Safe temp.	Time duration needed to reach safe temperature
1	**Starbucks**	**61º C**	60 º C	3'
2	**J-Coffee**	**65 º C**	60 º C	4'50''
3	Kopi Kenangan	60 º C	60 º C	-
4	Janji Jiwa	44 º C	44 º C	-
5	**Dunkin**	**81 º C**	60 º C	26'53''
6	**Foresthree**	**65 º C**	60 º C	8'
7	Kopi Manao	48 º C	48 º C	-

8	Baraja Coffee	49 ° C	49 ° C	-
9	Kopi Roemah Kesambi	46 ° C	46 ° C	-
10	Papper & Sip	51 ° C	51 ° C	-
11	Little Black	50 ° C	50 ° C	-
12	**Kepincut Coffee**	**68 ° C**	60 ° C	8'30"
13	Tiga Delapan Gelato & Coffee	47 ° C	47 ° C	-
14	**Ini Kopi Ulon**	**65 ° C**	60 ° C	3'30"
15	Coffee by Meraki	43 ° C	43 ° C	-
16	**Fore Coffee**	**65 ° C**	60 ° C	5'
17	Kalula Coffee	50 ° C	50 ° C	-
18	Segia	50 ° C	50 ° C	-
19	Castrena Coffee	59 ° C	59 ° C	-
20	Shaka Coffee	53 ° C	53 ° C	-
21	Loko Coffee	54 ° C	54 ° C	-
22	Lynne's Coffee and Kitchen	60 ° C	60 ° C	-
23	Kopi Tomo	55 ° C	55 ° C	-
24	E Space Coffee	49 ° C	49 ° C	-
25	Kopi.Kyu	49 ° C	49 ° C	-
26	CeuCeu Coffee	49 ° C	49 ° C	-
27	Kopi Poelen	50 ° C	50 ° C	-
28	Mekayo Coffee	48 ° C	48 ° C	-
29	Kopi Nako	52 ° C	52 ° C	-
30	Point Coffee – Indomart	55 ° C	55 ° C	-
31	Beans Spot – Alfamart	78 ° C	60 ° C	-
32	Toa Baja Coffee	55 ° C	55 ° C	-
33	Canggu Coffee House	41 ° C	41 ° C	-
34	Babeh House Blend	49 ° C	49 ° C	-
35	Ruang Tengah	44 ° C	44 ° C	-
36	**Lain Hati**	**78 ° C**	60 ° C	10'32"
37	Coffee Boss	53 ° C	53 ° C	-
38	Famous	47 ° C	47 ° C	-
40	Kamala	48 ° C	48 ° C	-
41	Coffeenology	45 ° C	45 ° C	-
42	Safty Coffee & Space	53 ° C	53 ° C	-
43	NIRI Coffee	50 ° C	50 ° C	-
44	Think Wonderful Coffee	47 ° C	47 ° C	-
45	Lyly Coffee	50 ° C	50 ° C	-
46	**Kopi Soe**	**71 ° C**	60 ° C	10'12"
47	Oksigen	43 ° C	43 ° C	-
48	Komunikoffie	40 ° C	40 ° C	-
49	Lambada	50 ° C	50 ° C	-
50	**Excelso**	**70 ° C**	60 ° C	9'30"
Mean		**54,1** ° C		**1'48" (total average)** **8' (among hotter coffee than safe temperature)**

DISCUSSIONS

The standard holding temperature for coffee, established by the Coffee Brewing Center (USA) and the Nordic Coffee Center (Norway), ranges from 80 ºC to 85ºC (175 ºF to 185ºF)[11]. However, serving temperatures might range from around 71ºC to above 85ºC (160 ºF to above 185ºF)[11,12] Brief exposures to liquids in this temperature range can cause significant scald burns.[12] Extensive research has shown that spills at higher temperatures up to 82 ºC (up to 180 ºF) are very likely to cause at least mid-dermal burns, which are very serious and often necessitate medical intervention. Some populations like children and elderly are more at risk for injury because of their thinner skin, inability to move quickly after a spill incident, and smaller body size. In addition to burn risk, The International Agency for Research on Cancer (IARC) states that "very hot" (>65 ºC) beverages are probably carcinogenic to humans, specifically the risk of developing oesophageal carcinoma.[13]

Our collected data showed that the serving temperature of the coffee latte in paper cups varied from 40ºC to 81ºC with the average temperature of the served coffee latte was at 54.1ºC. We acknowledged that there are many references regarding the serving temperature for a cup of coffee. Borchegrevink and colleagues reported the ideal temperature for serving to

be between 62.8 ºC to 68.3ºC.[8,11]. Pipatsattaayanuwong and colleagues reported that the most preferred temperatures are in the 71.4ºC (161.8ºF) range[14]. Lee and Mahoney reported that the mean preferred temperature was 59.8ºC (139.6ºF).[14] Brown and colleagues reported that the optimum temperature range was approximately 57.8ºC (136ºF).[12,14] Stokes and colleagues reported that the optimal temperature for hot coffee was 70.8ºC (159.4ºF). Dirler and colleagues reported that the average preferred drinking temperature was 63ºC (145ºF).[14] The fact that our finding is slightly different from the aforementioned studies may be a result from the different types of coffee beans, mixtures, and cups used for serving.[8] Coffee makers and coffee drinkers in tropical countries also favour their coffee in milder temperature compared to ones from countries with colder temperature. Our study utilized non-sugar coffee lattes with consideration that younger people are not familiar with ordering coffee without foamed milk and latte variants are the most commonly ordered products. We did not put sugar or sweetener because adding more substances like sugar or creamer can lower the serving temperature even more.[8]

The American Burn Association states that a scalding injury can occur immediately when skin is placed in contact with water measuring 155ºF or 68ºCC, at 148ºF or 64ºCC scalding injuries may occur within the first two seconds and at 140ºF or 60ºC within five seconds.[15] We put a value of 60ºC not a higher temperature as the safe temperature threshold in our study with the consideration that some population such as children and the elderly who do not have a quick reflex are at risk of having a longer duration of contact before having their first aid. One study from Abraham and colleagues reported that spills over 82ºC (179ºF to 180ºF) will likely lead to mid-dermal burns for adults and all beverage volumes.[15] On the other hand, for children, mid-dermal burns are predicted to occur at lower temperatures.[15] They also reported that conditions risking deep partial thickness or worse scald wounds are hot beverages in an uncapped cup at 85ºC (185ºF) without cooling time, or ones in a capped cup still within 1 minute cooling time. Hot beverages in an uncapped cup at 85ºC (185ºF) within 12 minutes of cooling time, or ones in a capped cup within 2 to 15 minutes are still at risk for superficial-partial-thickness burn.[16] They also discovered no burn injury was reported when hot beverages served in less than 70ºC (158ºF) in an uncapped cup after 3 minutes of cooling time and after 7 minutes of cooling time in a capped cup.[16]

Our study found that most of the coffee outlets (80%) served their products in paper cups within safe temperature (60ºC or lower) and the average temperature of the served coffee latte was also within safe limit (54.1ºC). However, we noticed there are 10 coffee outlets that served hotter coffee latte than our temperature of safety recommendation 60ºC, and 5 of them serving hotter coffee latte than 68ºC which risk a scalding injury immediately after contact. We also reckoned the mean time duration needed from the serving temperature to safe temperature for drinking was a minute and 48 seconds, which is still inside a golden period of a three-minute ripening to improve the flavour quality of brewed coffee.[8]

Our study result showed the average serving temperature of coffee latte variants are at 51.9 ºC and that does not correspond well to a study from Abraham and colleagues who reported that, in term of balancing safety and consumer preference, recommended serving temperatures are at 54ºC to 71ºC (130 ºF to 160ºF) while the ideal brewing temperature is still at 91ºC (195ºF).[14] Although 40 of 50 (80%) coffee outlets serving their coffee within a safe 60ºC and customers can drink them immediately at serving temperature without additional cooling time, there are still 20% coffee outlets that need to inform their customer the necessity to cool down their coffee for a certain time. On the other side of the story, 62% (31 of 50) coffee outlets served their coffee in lower temperature than 54ºC --the recommended temperature of consumer satisfaction according to Abraham's study. It seems that coffee makers and coffee drinkers in tropical countries favour their coffee in milder temperature compared to ones from countries with colder temperature, although such theory needs further study.

CONCLUSIONS

Burn injuries resulting from hot coffee consumption are a serious public health concern, with scalds being a major contributor to such injuries. While coffee brewing and serving temperatures recommended by the hospitality and food science literature are generally higher, they pose a significant risk of scald burns, especially for vulnerable populations like children and the elderly. Our study in Cirebon, West Java, found that the average serving temperature of coffee lattes in paper cups was 54.1°C, which falls within the safe threshold for immediate consumption. However, some coffee outlets served hotter coffee, putting customers at risk of scalding injuries. It is essential for coffee outlets to adhere to safe serving temperatures and educate consumers on the need for cooling time when necessary. By promoting safer coffee consumption practices, we can reduce the incidence of scald burns and improve the overall safety and enjoyment of this popular beverage.

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