Original Article

Effect of drinking Arabian Qahwa on fractional exhaled nitric oxide levels in healthy nonsmoking Saudi adults

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Abstract:

OBJECTIVES: Fractional exhaled nitric oxide (FENO) is an emerging marker of inflammation in respiratory diseases. However, it is affected by a number of confounding factors. We aimed to study the effect of drinking Arabian Qahwa on FENO in non-smoking Saudi healthy adults.

METHODS: We recruited 12 nonsmoker healthy male adults aged 36.6 ± 2.7 (21-50) years. All subjects were free from acute respiratory infections or allergies and had normal ventilatory functions and serum IgE levels. At 8 am in the morning, their baseline values of FENO were recorded. They had not taken tea or coffee in the morning and had taken similar light breakfast. They were given three cups of Arabian Qahwa to drink and then after every 30 minutes, serial levels of FENO were recorded.

RESULTS: Average FENO levels at baseline were 28.73 ± 9.33 (mean ± SD) parts per billion (ppb). The mean FENO levels started to decrease significantly after 30 minutes of drinking Arabian Qahwa (P=0.002). This decrease in FENO level was further observed till two hours after Qahwa drinking and then it started to increase in next 90 minutes but still was significantly lower than the baseline (P=0.002). The mean FENO level recorded after 4 hours was 27.22 ± 10.22 (P=0.039).

CONCLUSIONS: FENO levels were significantly lowered by intake of Arabian Qahwa and this effect remains for about 4 hours. Therefore, history of recent Qahwa intake and abstinence is essential before performance of FENO and its interpretation.

Key words:

Arabian Qahwa, adults, fractional exhaled nitric oxide, non smoker

Fraction of exhaled nitric oxide (FENO) is an emerging marker of inflammation in respiratory diseases[1] Nitric oxide (NO) is produced from the conversion of L-arginine to NO and citrulline by nitric oxide synthases (NOSs)[2] which has three distinct isoforms; neuronal NOS, inducible NOS, and endothelial NOS. Constitutive expression of NOS1 produces low levels of NO in healthy lungs. Inducible nitric oxide synthase 2A is thought to be responsible for the increased levels of NO produced in inflammatory states in the lung, and is markedly upregulated by interferon-γ, tumor necrosis factor-α, and interleukin-1β, and downregulated by corticosteroids. The enzyme iNOS generates extraordinarily high concentrations of NO when the body mounts an inflammatory response by attracting macrophages, which generate NO to participate in host defense against specific organisms.[3] In biologic specimens, NO is highly reactive and is rapidly converted into peroxynitrite through its reaction with superoxide.[4] FENO is affected by a number of confounding factors such as drinking and eating; therefore, it is advisable for the patients to refrain from these activities before analysis. An increase in FENO has been found after the ingestion of nitrate or nitrate-containing foods, such as lettuce (with a maximum effect 2 hours after ingestion),[5,6] and drinking of water and ingestion of caffeine may lead to transiently altered FENO levels.[7,8] It is possible that a mouthwash may reduce the effect of nitrate-containing foods.[5] Until sufficient evidence is available, it is prudent when possible to refrain from eating and drinking for 1 hour before FENO measurement, and to question patients about recent food intake. Additionally, alcohol ingestion also reduces FENO in patients with asthma and healthy subjects.[9,10] Arabian Qahwa is widely used in the Arab world. Therefore, we aimed to study the effect of drinking Arabian Qahwa on FENO in healthy adults.

Methods

This study was conducted in the department of Physiology, College of Medicine and King Khalid University Hospital, King Saud University, Riyadh, Saudi Arabia. Written informed consent was obtained from all subjects and the project was approved by the College of Medicine Ethics Review board. We recruited 12 healthy nonsmoker male adults aged 36.6 ± 2.7 (21-50) years. All subjects were free from acute or chronic respiratory infections and allergies. They were

included in the study if they were nonsmokers, had no recent or current upper respiratory tract infection, were not on any medications, and had neither atopy nor clinical manifestations of allergic diseases. In addition, all subjects included in the study had normal ventilatory functions on spirometry and serum IgE levels. Patients were excluded from the study if they had physician diagnosis of respiratory disease, symptoms of respiratory disease in the last one year, or were on inhaled medications.

They were called at 8:00 am in the morning and baseline values of FENO were recorded which acted as control values. They had not taken tea or coffee in the morning and had taken similar light breakfast. They were given three traditional cups (about 180 ml) of freshly prepared Arabian Qahwa to drink and then after every 30 minutes, serial levels of FENO were recorded for a period of 4 hours. The ingredients of the Arabian Qahwa prepared were water, ground coffee beans, cardamom (coarsely ground), ginger powder, and saffron.[11]

Measurements of fractional exhaled nitric oxide

FENO measurements were performed according to the present recommendations of American Thoracic Society[12] using a NOX EVA 4000 chemiluminescence analyzer (SERES-FRANCE) with a sensitivity of 1 part per billion (ppb). All subjects were asked to refrain from eating, drinking, and strenuous exercise for 2 hours before FENO measurement. The history of recent meals was also recorded to avoid any alteration in results by nitrate-containing foods. As an additional precaution, all tests were performed at the same time of the day between 08:00 am and 12:00 noon to minimize possible circadian effects. Using online visual monitoring, the subjects were asked to inhale from residual volume to total lung capacity and then performed a slow expiratory vital capacity maneuver with a constant standardized expiratory flow rate of 0.05 l/sec (±10%) resulting in an expiration time of about 20 seconds, into a Teflon cylinder connected to 3-mm Teflon tubing, without clipping the nose.

To exclude nasal NO contamination, an expiratory resistance of 10 to 20 cm H_2O was applied. This expiratory resistance was measured by a special pressure sensor (SAMBA 3200 pressure measurement system) connected to restricted breathing configuration set up (Samba Sensors, Vastra Frolunda, Sweden). The subjects inspired from NO-free air and expired in restricted-breath configuration set up. The expiratory flow rate was measured by data acquisition system BIOPAC MP-100 (Biopac Systems Inc, USA). Plateau levels of FENO against time were determined and expressed as ppb.

Mean exhaled NO concentrations were determined between 5 and 15 seconds after start of the expiration. Three successive recordings were made at least at 1 minute intervals and the mean was used in analysis. To ensure standardization and reproducibility, the acceptable variation between the tests was kept less than 10%. NO measurement set up was calibrated before each test using a standard NO calibration gas. Ambient NO levels were recorded and, if >40 ppb, the analyzer was flushed with NO-free gas.

Statistical analysis

We used SPSS version 19.0 to perform the data analysis. The data were presented as Mean ± SD and as percentage values. We used test of normality to check if FENO data were following normal distribution or not by using Kolmogorov-Smirnov test of normality and observed that our data were not following normal distribution. Therefore, we used non-parametric Friedman test and Wilcoxon Signed Ranks test to compare between FENO data at different time intervals. Friedman test was used to compare between the data at different time intervals and the difference was significant (P<0.0001). Comparison of FENO between different time intervals and baseline was analyzed by Wilcoxon signed-rank test. Significant difference was considered if P<0.025 (two tailed).

Results

This study highlights the effects of Arabian Qahwa on FENO levels in nonsmoking healthy adults. A total of 12 healthy subjects participated in the study. Table 1 shows demographic characteristics and ventilatory function tests in all study subjects. We recorded their baseline control values and then after intake of Arabian Qahwa, their serial FENO levels were measured after every 30 minutes for up to four hours. Table 2 shows FENO values at baselines and at different intervals of 30 minutes up to 4 hours of Qahwa intake. The mean baseline FENO level in the study subjects was 28.73 ± 9.33 ppb (mean ± SD). Figure 1 expresses the percentage change in the FENO levels from the baseline at 30 minutes of intervals after drinking of Arabian Qahwa. The mean FENO levels started to decrease significantly after 30 minutes of drinking Arabian Qahwa (P=0.002). This decrease in FENO level was further observed till two hours after Qahwa drinking and then it started to increase in next 90 minutes but still was significantly lower than the baseline (P=0.002). The mean FENO level recorded after 4 hours was 27.22 ± 10.22 (P=0.039).

Discussion

This is first study to report the effect of Arabian Qahwa intake on FENO levels in healthy adults. FENO measurements are becoming more popular in respiratory laboratories. Recent guidelines of ATS suggested that reduction of at least 20% in FENO for values over 50 ppb or more than 10 ppb for values lower than 50 ppb should be considered as the cut point to indicate a significant response to anti-inflammatory therapy. However, this recommendation has low quality of evidence.[12]

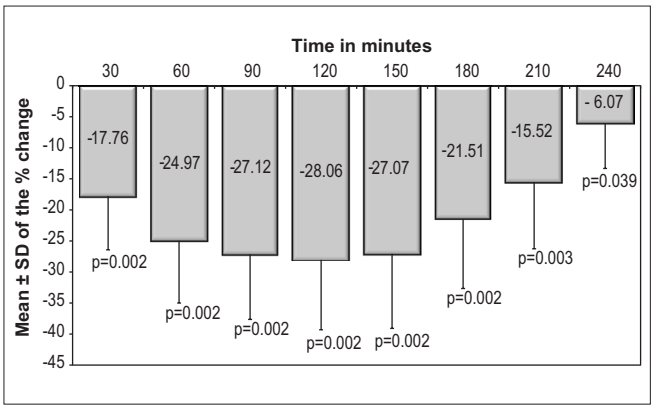

Figure 1: Percentage change in FENO values from baseline after Arabian Qahwa intake P<0.025 is significant

Table 1: Demographic characteristics and ventilatory function tests in all study subjects (N = 12)

	Mean ± SD
Age (years)	36.6 ± 2.7
Height (cm)	168.08 ± 6.8
Weight (kg)	76.02 ± 8.3
BMI	28.73 ± 9.3
FVC (liters)	3.73 ± 0.53
FEV1 (liters)	3.253 ± 0.43
FEV1%	85.92 ± 2.24

BMI = Body mass index; FVC = forced vital capacity; FEV1 = forced expiratory volume in 1 s

Study by Elizabeth S. Taylor *et al*.[13] showed that recent caffeine consumption does not affect exhaled NO levels in patients with asthma. However, Bruce *et al*.[8] reported that FENO levels decreased significantly with caffeine intake in healthy volunteers. In our study, we also observed that Arabian Qahwa decreased FENO levels by more than 20%. Additionally, Warke TJ *et al*. concluded that levels of exhaled NO are significantly increased compared with baseline values half an hour after caffeine consumption and have returned to baseline levels after one hour. However, this was an open-label, uncontrolled investigation in healthy subjects, which makes interpretation difficult.[14] An inverse association has been reported between coffee intake and inflammatory markers and endothelial dysfunction. This highlights the fact that coffee consumption may reduce inflammation and markers of endothelial activation.[15] Coffee may favorably affect endothelial atherosclerotic plaques through this pathway, because oxidized low density lipoprotein (LDL) is present in atherosclerotic lesions enhancing the process.[16] Yukawa *et al*.[17] conducted an in vivo study with 11 healthy males who drank 24 g coffee/d for 1 week and found that regular coffee ingestion reduced LDL oxidation susceptibility. Another beneficial effect was reported that caffeine appears to improve airways function modestly, for up to four hours, in people with asthma.[18] People may need to avoid caffeine for at least four hours prior to lung function testing, as caffeine ingestion could cause misinterpretation of the results. Drinking caffeinated coffee before taking exhaled NO measurements does not appear to affect the results of the test, but more studies are needed to confirm this. In this database, they also reported about a trial involving 20 people regarding the effect of drinking coffee vs a decaffeinated variety on the exhaled NO levels in patients with asthma and concluded that there was no significant effect on this outcome. However, we observed that Arabian Qahwa significantly lowered FENO levels in healthy volunteers, reflecting that the effect may be due to some additional ingredients of Qahwa. Abuzayan *et al*.[19] reported that ingestion of a caffeine-containing cola drink was associated with a modest and transient rise in FENO and may result in clinically relevant acute changes in children with asthma. While reporting FENO levels, the history of intake of Arabian Qahwa must be taken into account. Moreover, it would also be feasible to give prior instructions to patients before doing FENO levels to refrain from Qahwa intake for at least four hours before the test. In addition, it would be important and interesting to study the effects of Arabian Qahwa in asthmatic patients because of its potential anti-inflammatory effects.[15] Moreover, studies are needed in asthmatic patients to see exact effects of different ingredients of Arabian Qahwa on FENO levels.

Table 2: FENO values at baselines and at different intervals after Arabian Qahwa intake

Time	Mean ± SD	95 % confidence interval of the mean (Lower bound – Upper bound)
Baseline	28.73 ± 9.33	22.79 – 34.65
30 min.	23.69 ± 8.77	18.12 – 29.26
60 min.	21.81 ± 9.16	15.99 – 27.63
90 min.	21.17 ± 9.01	15.44 – 26.89
120 min.	20.98 ± 9.18	15.14 – 26.82
150 min.	21.34 ± 9.68	15.19 – 27.49
180 min.	22.92 ± 9.79	16.71 – 29.13
210 min.	24.61 ± 10.06	18.21 – 30.99
240 min.	27.22 ± 10.22	20.73 – 33.71

Conclusions

FENO levels are significantly lowered by intake of Arabian Qahwa and this effect remains for about four hours. Therefore, history of recent Arabian Qahwa intake and abstinence is essential before performance of FENO for exact interpretation of its values.

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