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Ginger and Human Vigilance

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Abstract
Background: Ginger and its active constituents play an important and vital role in neuroprotection and acceleration of brain functions mainly via shogaol active ingredient which prevents transient cerebral ischemia, antioxidant effect and up-regulation of antioxidant enzyme levels. **Aim:** The aim of the present study was to elucidate and evaluation of Ginger in young human vigilance and psychomotor performance. **Subjects and Methods:** Forty five healthy volunteers with age ranged from 21-23 years were recruited into this pilot study. The volunteers were divided into two groups, group I (placebo group):20 volunteers received an inert substance (500mg starch capsule) daily for five consecutive days. Group II (treated group):25 volunteers received 500 mg Ginger daily for five consecutive days. Before taking the treatment and placebo pre-treatment scores were measured, then soon after completing these measurements a post-treatment score were measured daily. Leeds psychomotor battery tester is a device that measured psychomotor performance, vigilance status and critical flicker fusion frequency was used in the present study. **Results:** Placebo, produced an insignificant effect (p>0.05) on all vigilance variables after five days of therapy with starch capsule 500mg/day, except for MRT placebo; demonstrated significant effects p=0.04, Ginger 500mg/day for five days lead to significant activation of most vigilance variables p<0.05 except on critical flicker frequency it produced insignificant effect p=0.08. **Conclusion:** Ginger improves psychomotor performances and vigilance task in normal healthy volunteers.

1. Introduction

The conventional herbal medicines with reliable ethnopharmacological possessions have newly been revealed to have neuroprotective and neurotrophic capabilities which can be helpful in ameliorating the cognitive function and vigilance (1).

Numerous ,natural product ingredients have been investigated for their central stimulant effects in improving memory and psychomotor performances, consequently; can be used in the treatment of cognitive deficit and neurodegenerative disorders through their anti-oxidant and anti-inflammatory properties (2).

Ginger (*zingiberofficinale*), plays an essential function in prevention of multiple disorders that ranged from anti-emetic effect to the potent anti-tumor effect, but the precise mechanism of Ginger is not entirely understood, but; it is thought that Ginger may produces specific effect through definite active constituents (3).The active constituents of *Gingerare paradol, shogaol, gingerol, zingerone,gingerenone A and 1-Dehydro-10-gingerdione*, as shown in figure (1). (4)

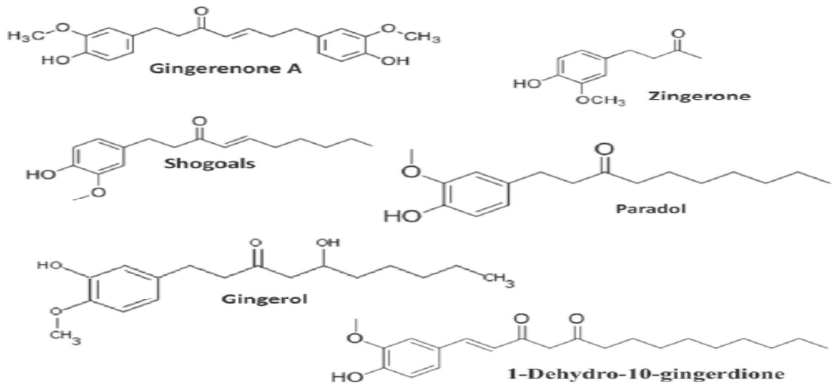

Figure (1). *Chemical structure of ginger active constituents.*

Ginger and its active constituents play an important and vital role in neuroprotection and acceleration of brain functions mainly via shogaol active ingredient which prevents transient cerebral ischemia, antioxidant effect and up-regulation of antioxidant enzyme levels in animal model studies(5).

Moreover, prolonged Ginger therapy protects the brain from oxidative and inflammatory damages through inhibition of microglial activation which related in progression of neurodegeneration and cognitive deficit (6) ,since ;oxidative stress donate and contribute in developments of cognitive impairment as age proceeded or due to various disorders that associated with oxidative stress as in diabetes mellitus (7).Additionally, different electrophysiological and neuropsychological studies documented the beneficial effect of Ginger as cognitive enhancing agent in improving memory and treatment of neurodegenerative diseases in middle aged women(8).

Therefore, the aim at the present study was to elucidate and evaluate the effect of Ginger on young human vigilance and psychomotor performance.

2. Subjects and Methods

Forty five healthy volunteers (20 females and 25 males) with age ranged from 21-23 years were recruited into this pilot study and all volunteers were previously qualified to starting the experiment at contented condition, in the Department of Pharmacology, College of Medicine, AL-Mustansiriyia University, Iraq Baghdad 2015.

The volunteers were divided into two groups, group I (placebo group):20 volunteers (10 males and 10 females) received an inert substance (500mg starch capsule) daily for five consecutive days. Group II (treated group):25 volunteers (10 females and 15 males) received 500 mg Ginger daily for five consecutive days.

Before taking the treatment and placebo, pre-treatment scores were measured, then soon after completing these measurements a post-treatment score were measured daily.

The drug and placebo were purchased from private pharmacies.

Leeds psychomotor battery tester (Zac-Gmbh.D-8346-Simbach/Inn) is a device that measured psychomotor performance, vigilance status and critical flicker fusion frequency was used in the present study.

3. Measurement of Arousal Cortical Activity (9)

These tests were done at morning at 10 a.m in dime light room, the device enclosed four red emitting diodes positioned into the center of a 2cm square on the top of dark board and the volunteer sat in front of tester with 75-100 cm distance (distance from the eyes to the diodes) to ensure the binocular vision.

The fusion frequency represents the frequency needed for perceiving flicker, red light as constant red light; it ranged from 30-60 Hz, while flicker frequency represents the frequency needed for perceiving constant red light as flickering red light it ranged from 1-30 Hz. The tester recorded and calculated the mean of five recorded measures, also minimum and maximum values were recorded, thus, from these measures different calculation formula can be calculated these are

Flicker index=max/max+min(maximum and minimum values in critical flicker frequency).

Fusion index =max/max+min(maximum and minimum values in critical fusion frequency).

CFFF=flicker frequency+fusion frequency /2.

4. Measurement of Psychomotor Vigilance Performances (10)

Leeds psychomotor tester measures total reaction time(TRT), recognition reaction time (RRT) and movement reaction time (MRT) through urgent key pressing as soon as possible when red light appeared randomly in response to pressing starting key of the device this repeated three times and the mean of these measures will appearing ,thus the time

from stating the stimulus to the beginning of motor action represent RRT, while, the time from starting of motor action to the end of response represent MRT, summing of both RRT and MRT called TRT, the time of the reaction time revealed was in ms which represent a choice and complex reaction to vigilance stimuli.

5. Statistical Analysis

Data expressed and presented as mean ±SE, they were analyzed via student t-test regarding p<0.05 as the lowest perimeter of significance.

6. Results

Placebo, produced an insignificant effect (p>0.05) on all vigilance variables after five days of therapy with starch capsule 500mg/day, except for MRT placebo; demonstrated significant effects p=0.04 table (1).

Table (1). *Effect of placebo on the vigilance variables (n=20).*

Vigilance variables	Before	After	*P* value
TRT ms	654.65±11.45	658.55±12.48	>0.05
RRT ms	368.69±2.34	367.66±2.33	>0.05
MRT ms	285.96±9.11	290.89±10.15	0.04*
C.Fusion F. Hz	30.22±1.21	30.11±1.14	>0.05
Fusion index Hz	0.502±0.05	0.506±0.04	>0.05
C.Flicker .F Hz	28.36±1.12	27.56±1.31	>0.05
Flicker index Hz	0.519±0.05	0.517±0.06	>0.05
CFFF Hz	29.29±1.16	28.83±1.22	>0.05

Results were expressed as mean±SE, TRT=total reaction time, RRT=recognition reaction time, MRT=movment reaction time, C.Fusion F=critical fusion frequency, C.Flicker .F =critical flicker frequency , CFFF=critical flicker-fusion frequency. *p significant effect.

Table (2). *Effect of Ginger on the vigilance variables (n=25).*

Vigilance variables	Before	After	*P* value
TRT ms	699.65±14.39	543.36±13.67	0.002
RRT ms	385.44±11.11	311.63±10.59	0.004
MRT ms	314.12±3.28	231.73±3.0.8	0.003
C.Fusion F. Hz	29.33±1.62	33.13±1.61	0.08
Fusion index Hz	0.516±0.05	0.523±0.04	0.04
C.Flicker .F Hz	28.44±1.55	26.22±1.23	0.01
Flicker index Hz	0.507±0.03	0.477±0.05	0.01
CFFF Hz	28.88±1.58	29.67±1.42	0.04

Results were expressed as mean±SE, TRT=total reaction time, RRT=recognition reaction time, MRT=movment reaction time, C.Fusion F=critical fusion frequency, C.Flicker .F=critical flicker frequency, CFFF=critical flicker-fusion frequency. *p significant effect.

Ginger 500mg/day for five days lead to significant activation of most vigilance variables, it reduced TRT from 699.65±14.39ms to 543.36±13.67ms (p=0.002), RRT from 385.44±11.11ms to 311.63±10.59 ms (p=0.004), MRT from 314.12±3.28 ms to 231.73±3.0.8 ms(p=0.003), Fusion index from 0.516±0.05 Hz to 0.523±0.04 Hz (p=0.04), C. Flicker .F from 28.44±1.55 Hz to 26.22±1.23 Hz (p=0.01), Flicker index from 0.507±0.03 Hz to 0.477±0.05 Hz (p=0.01) and CFFF from 28.88±1.58 Hz to 29.67±1.42 Hz (p=0.04) but, Ginger produced insignificant effect on critical flicker frequency (p=0.08) table (2).

Regarding Ginger versus placebo differences on cortical arousal function that reflected in MRT,RRT and TRT there are significant differences in pre and post effects of Ginger p<0.05 ,while placebo effects shows insignificant differences p>0.05 figure (2).

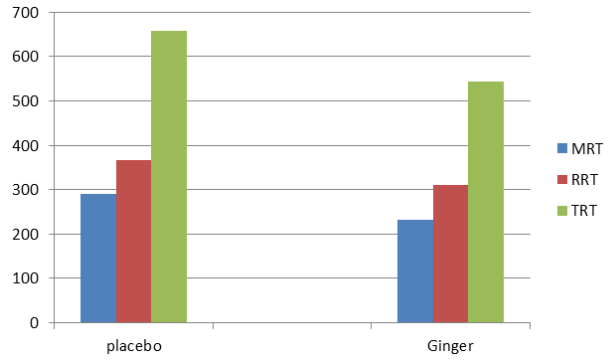

Figure (2). *Ginger versus placebo effects on cortical arousal function.*

Regarding Ginger versus placebo differences on the central integrity process that reflected in critical fusion frequency, critical flicker frequency, and critical flicker-fusion frequency. There are significant differences in pre and post effects of Ginger p<0.05, while placebo effects show insignificant differences p>0.05 figure (3).

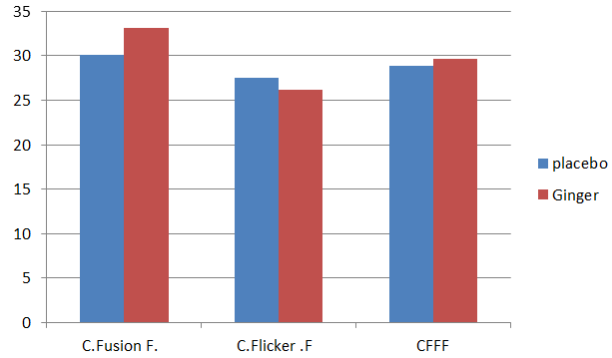

Figure (3). *Ginger versus placebo effects on central integrity process.*

7. Discussion

The present study noticeably reveals that ginger may enhance vigilance ,cognitive and attention functions in young healthy volunteers and Ginger, significantly improves all psychomotor vigilance parameters and cognitive central integrity process that, reflected by the acceleration in the critical flicker frequency and critical fusion frequency .Previously ,numerous studies illustrated that event related psychomotor and CFFF components are sensitive to the vigilance and attention functions which corresponds to mental process such as recognition and stimuli classification ,and it has been reported that attention power can be accessed via RRT, TRT and MRT (11).

Also, Ginger enhances brain function and competence of cognitive process through cognitive performance, since;

cognitive alteration was more sensitive to the effect of Ginger active constituents (12).

Furthermore, Ginger may enhance vigilance and attention through stimulation the releasing of dopamine, serotonin and noradrenalin in cerebral cortex (13). Additionally, Ginger increases the cortical acetylcholine level through inhibition of acetylcholinestrase enzymes that leading to the augmentation of vigilance and learning (14).

Thus, vigilance enhancing effects of Ginger may be through modulation of cholinergic and monoamine systems of prefrontal cortex and hippocampus, consequently; an earlier and preceding study demonstrated that the lateral prefrontal cortex plays an essential role in decision-making function and wakefulness during reaction time (15).

Moreover ,an antioxidant consequence may be responsible for the Ginger's improvement effects on cognitive performance and vigilance for; antioxidant agents improve and accelerate cognitive function (16). Ginger and its active constituents decrease oxidative stress during cerebral infarction through activation and upregulation of antioxidant enzymes at cerebral cortex, striatum and hippocampus which per see inhibiting lipid peroxidation (17).

Likewise, insufficiency of cerebral glutathione leads to impairment of cognitive function and psychomotor performance through functional and structural neuronal dysfunction, thus; Ginger improves sensory-motor motivation capacity and vigilance function via activation of cerebral glutathione (18).

Previous animal model studies demonstrated that mice lacking the gene encoding for ascorbate lactone oxidase undergo cognitive dysfunction, also; ascorbate overturns scopolamine induced cognitive dysfunction, thus; Ginger antioxidant effect may act in a similar manner of ascorbic acid in free radical scavenging, since Ginger and other antioxidant may activate cholinergic neurons in median forebrain bundles which responsible for vigilance activation (19, 20).

All these effects may explain the quickening in critical flicker frequency and psychomotor vigilance task in the present study, which reproduce cognitive enhancing effects on normal healthy volunteers.

Moreover, a large dose of Ginger was able for induction into cerebral vasodilatation and increasing in the neuronal density and it was reported that during vigilance and attention the cerebral blood flow augmented and any reduction in blood flow during vigilance cognitive task and vigilance performances resulting in cognitive impairment , and through this effects Ginger can prevent brain damage-induced cognitive deficit also; Ginger reduced cortical infarct size during cerebral ischemia which reflects a neuroprotection effect of Ginger(21).

AChE inhibitor improves cognitive deficit following to stroke, and it was established that Aricept, which is an AChEI and antioxidant, the neuprotection of Aricept was mainly linked to the antioxidant effect rather than to the AChEI activity, since; Ginger have both AChEI and antioxidant effects so; it produced a more pronounced effect in activation of vigilance and cognitive function (22) as demonstrated in the present study.

Furthermore, Ginger possesses anti-inflammatory action via inhibition of COX-2 and lipoxygenase enzymes, also; it inhibits pro-inflammatory cytokines, including IL-12 and IFN mainly via ginerol active constituent which explained the beneficial effects of Ginger in prevention and attenuation of neuroinflammatory disorder (23). Additionally, COX-2 inhibitors improve psychomotor performance activity in normal healthy volunteers which give a clue to the possible influential effect of Ginger in advancing the vigilance and psychomotor performance (24).

Therefore, all these studies are in corresponding with results of the present study, which pointed out that Ginger improved vigilance and attention and can be used as monotherapy or adjuvant in the treatment of cognitive deficit in diseased patients and normal person.

8. Conclusion

Ginger improves psychomotor performances and vigilance task in normal healthy volunteers.

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