

The Study of Brainwave and Attentive Processing in Cumulative Drinking Black Tea

Ekasit Lalitsuradej¹

Prof. Dr. Werner Kurostchka²

Dr. Ariya Sarikaphuti³

Assistant Professor Dr. Wichian Sittiprapaporn⁴

ABSTRACT

This independent study was intended to study the brainwave activities and attentive processing in cumulative drinking of black tea. The Tea Phanna, a black tea, produced by the SriNapan-Tawane Community, Nan province was used in this study. *Purposes:* To study brainwave and attention in cumulative drinking of black tea. *Method:* 20 urban working people were enrolled to the study. Brainwaves in each participant were recorded by Brain Actor 2 channels Electroencephalogram (EEG). The attention was investigated by spatial test of mechanical aptitude and spatial relation test. Brainwaves were recorded at the time of eyes closed, eyes open and doing spatial test before drinking black tea. The participants were asked to drink black tea every 10 minutes alternately with doing spatial test until 30 minutes. Brainwaves also recorded at the time of doing spatial test with eyes closed and eye open after drinking black tea. *Results:* Cumulative drinking of black tea showed increased of alpha waves after 10 minutes of drinking black tea along doing the spatial test ($p < 0.05$). The effect associated with decrease of reaction times in spatial test, nevertheless, not number of correction ($p < 0.05$). *Conclusion:* Brainwaves mainly in cumulative drinking black tea were alpha wave and associated with reaction time doing test.

Keywords: Brainwave / Attentive process / Cumulative drinking / Tea / Black Tea

¹ Graduate Student, Master of Science in Anti-Aging and Regenerative Science, School of Anti-aging and Regenerative Medicine, Mae Fah Luang University email: linekasit@gmail.com

² Advisor, Department of Anti-Aging and Regenerative Science, School of Anti-aging and Regenerative Medicine, Mae Fah Luang University email: drkuro@aol.com

³ Co-advisor, Department of Anti-Aging and Regenerative Science, School of Anti-aging and Regenerative Medicine, Mae Fah Luang University email: unique21th@yahoo.com

⁴ Co-advisor, Department of Anti-Aging and Regenerative Science, School of Anti-aging and Regenerative Medicine, Mae Fah Luang University email: drwichian.s@gmail.com

1. Background and Reason

The urban lifestyle and a busy life all day makes people, nowadays, concern about their brain health and potential of their brain. Therefore, food or diet for brain is one of trend today. Besides, the brain function monitoring by many brain measurements are one of the interesting issues (R. Anand *et al.*, 2011).

The brain is the largest electricity generator in the body. Brain electricity can be defined as brainwaves. The variety of brainwaves is influenced by neurotransmitters-neurochemical that affects neurone function-that could affect health promotion in various aspects. 4 types of brainwaves have to be recognized, Beta, Alpha, Theta and delta (Braverman *et al.*, 2012). Each type of brainwave could be affected by nutrients or substances from foods or beverages (de Jager and Kovatcheva, 2010). This effect could promote regeneration or degeneration of total health benefits. To finding beverages that we could find in daily life, therefore, could promote long term brain health.

Tea, *Camillia sinensis*, is one of the most popular beverages consumed in the world. There are many types of tea which differentiate by fermentation process. Approximately three billion kilogrammes of tea is produced and consumed yearly. Many kinds of tea are consumed in different parts of the world. Green tea, which is 20% of consumption, is favoured in Japan and China. 78% of tea consumption is black tea, which is consumed in Western countries and 2% is Oolong tea which is produced (partially fermented) mainly in southern China (Khan and Mukhtar, 2007). Tea has broad

health benefits from green tea to black tea due to its plant chemicals. Catechin is the main compound which is found in green tea whereas Theaflavin is mainly found in black tea. Not only theaflavin is found in black tea but thearubigins, Theobromine, Theophylline, Theanine and caffeine also (Khan and Mukhtar, 2007; Pinto, 2013). These kinds of components make various benefits for health such as antioxidant, anticancer, antiatherosclerotic effect, moreover, brain health promotion such as Alzheimer's disease, Parkinson even increase attention (Sharangi, 2009; Ruxton, 2009). A review by Ruxton summarised 23 studies on the impact of caffeine on cognitive function finding positive effects on mood, alertness, mental performance at acute intake 37.5 – 450 mg (Ruxton, 2009). Interestingly, caffeine is known to inhibit neurotransmitters that slow down brain activity and influence others that alter mental performance such as noradrenaline, dopamine and serotonin as the study from Fredholm (Ruxton, 2009). All this information was the reason for this study to study brainwaves and attentive processes in cumulative drinking of black tea in order to promote longevity and health. This study had been set to prove 2 main hypotheses, the first hypothesis was brainwaves could be changed after cumulative drinking black tea and the second was attentive processes could improve in cumulative drinking of black tea.

2. Objectives

1. To investigate attentive process in cumulative drinking of black tea.
2. To investigate brainwave in cumulative drinking of black tea.

3. Methodology

Twenty participants (12 females and 8 males) aged between 25-55 years old were participated in this study. All participants had occupation in the area of health care and promotion. Brainwaves activities were recorded by 2 channels electroencephalogram (EEG). All electroencephalographic data were then computed by LearnMon programme version 1.72. The attentive process was measured by using the Spatial Relationship Sub-test of the Mechanical Aptitude and Spatial Relationships Tests by Joan and Norman (2004). All data were analyzed by pair-t-test. The analysis of all brainwave types were done by wide range frequency (2-64 Hz), Beta brainwave (13-30 Hz), Alpha brainwave (8-12 Hz), Theta brainwave (4-7 Hz) and Delta brainwave (0.5-3 Hz), respectively.

4. Results

Regarding to a wide range frequency (2-64 Hz), according to mean of frequency shown in this range at Fz electrode site, dominant frequency was Theta brainwave; nevertheless, at Cz electrode site, the dominant data was Alpha brainwave. There was no significant changing of frequency and spectrum in the frequency band at p-value < 0.05. Regarding to data in beta brainwave frequency, frequency of beta waves only showed changing only during eyes closed period when comparing between before and after drinking black tea. The frequency only changed at Fz position, p-value < 0.05. Regarding to data in alpha brainwave frequency, the frequency of alpha brainwave showed significant change between during spatial test at 10th, 20th and 30th minute after drinking black tea. The frequency of alpha waves at Fz position was increase at 10th minute and decrease a bit at 20th minute. Finally, it increased again at 30th minute after drinking black tea. Nevertheless, spectrum of alpha at Fz position wave showed a decreased significantly at 30th minute after drinking black tea when compared from 10th minute after drinking black tea (p<0.05). Regarding to data in theta brainwave frequency, the theta brainwave showed different changing significantly only during eyes closed period. The spectrum of theta waves showed decrease significantly between before and after drinking black tea at Cz position, p-value < 0.05. Finally, at delta brainwave, frequency of delta brainwave at Fz position showed decrease at 30th minute (p<0.05); nevertheless, spectrum of delta brainwave showed increase, significantly, at Fz position also (p<0.05). Moreover, frequency of delta brainwave also showed significant decrease at 30th minute when compared to 10th minute after drinking black tea (p<0.05).

5. Discussions

The aim of the current study was to find out whether there was an influence of black tea on brainwave and attentive process in a cumulative drinking period. In the current study, the influence to brainwave and attentive process were tested by experimental design. The study indicated that 3 kinds of dominant brainwaves, Beta brainwave, Alpha brainwave and Delta brainwave were shown during spatial test after drinking black tea.

Interestingly, frequency of alpha brainwave along cumulative drinking of black tea was shown significantly since the 10th minute; however, spectrum of the alpha brainwave changed significantly after drinking black tea, after 30th minute. This effect associated with decreasing reaction time of doing spatial test which corresponded to improved attentive processes. The improvement of attention was associated with Bruin's study that also improved attention (De Bruin *et al.*, 2011). The influence of black tea in this study to attention associated with a study of Bruin that black tea improved reaction times on the sensory-attention test (De Bruin *et al.*, 2011), nevertheless, not associated with Bruin's study in accuracy. Accordingly, alpha brainwave benefits corresponded to memory storage and processing (Bravermann *et al.*, 2012). Alpha brainwaves are still associated with alertness and peacefulness (Sittiprapaporn, 2013; Huang and Charyton, 2008). Alpha brainwave in current study are dominantly shown on Fz position where associated with working memory and also attention, according to Broadmann cortical area (Cortical Functions, 2012). This effect of alpha brainwave could be associated with attention on doing spatial test together ingredients from black tea, Theanin (De Bruin *et al.*, 2011), which is known to help attention and increase alpha wave activity according to a study of Gomez-Ramirez and Owen (Bryan, 2008). Alpha brainwave has shown on Fz position, though, it is also shown on Cz position which corresponded to somato association cortex, according to Broadmann cortical area (Cortical Functions, 2012). This position related to working memory from visual and visuomotor attention (Cortical Functions, 2012). Spectrums of alpha waves from this position were associated with doing visual spatial test of participants.

The time of cumulative drinking black tea also showed beta waves in the period of eyes closed compared to before and after drinking black tea. Beta brainwave showed on Fz position. This position also refers to eye movements (Cortical Functions, 2012). This effect can refer eye movements in eyes closed period effected by beta wave activity. The last interesting brainwave shown in this study was delta brainwave. Delta brainwaves are related to complex problem solving (Sittiprapaporn, 2013) and synchronization (Bravermann *et al.*, 2012). Delta waves were shown dominantly at Fz position which is associated with executive function memory and attention according to Broadmann cortical areas (Cortical Functions, 2012). According to the times of delta wave showing, delta waves presented dominantly since 30th minute after drinking black tea both frequency and spectrum at Fz position. It could be assumed that the solving of spatial test at 30th minute after drinking black tea was more complex than 10th or 20th minute; otherwise, cumulative drinking black tea could present the effect from 30th minute after drinking black tea. In conclusion, cumulative drinking of black tea could help promote alpha brainwave which help relaxing and attention. This could promote longevity for brain health in the term of improving attention with no stress.

6. Suggestions

There are some suggestions that should be done to understand the association of black tea, brainwave and health promotion. The suggestions were shown as below.

6.1. With the reference of ingredients of black tea by Ruxton, there are some ingredients that may be main active ingredients to brain. Some main ingredients such as Thearubigins, Caffeine and Theaflivins should be measured and compared to effects of each main ingredient. This could help us to explain more specific effects of black tea on brainwaves and attention.

6.2. In order to expand the explanation of brainwaves affected by black tea, the further study should study rural people who may have an easy lifestyle. This could help us to understand more effects of black tea.

6.3. According to the equipment, Brain Actor 2 channels EEG, could help us to understand the limited information of brainwaves. The suggestion is to do more experiments on other types of equipment in order to find more effects to brainwaves of black tea on other sides of the brain.

6.4. Interestingly, spectrum of beta brainwaves and theta brainwaves show a bit of a decrease at 10 minutes after drinking black tea before increasing again at 20 minutes after drinking black tea. Regarding to alpha waves also showed at 20 minutes after drinking black tea. It's expected that beta, theta and alpha waves could be affected on brain functions after 20 minutes. In order to understand more of this effect, the experiment is suggested to extend the time to more than 30 minutes such as 40 minutes.

6.5. In order to have a clear picture of cumulative drinking of black tea, the comparison of experiment or control experiment should be set by using warm water. This could help explain more effects of black tea.

7. References

- Braverman E., Watt T.J. and Bajaj A. (2012). *Cognitive diseases & impairments: diagnostic, prevention and therapeutic interventions*. Health Practitioner's Guide to Anti-aging & Regenerative Medicine. 1st Edition: 209 – 262.
- Bryan, J., Tuckey, M., Einöther, S. J., Garczarek, U., Garrick, A. & De Bruin, E. A. (2012). Relationships between tea and other beverage consumption to work performance and mood. *Appetite*, 58(1), 339-346.
- Celeste A de Jager and Assia Kovatcheva. (2010), Summary and Discussion: Methodologies to assess long term effects of nutrition on brain function. *Nutrition Review*. 68 (Suppl.1):S53 – S58.
- Cortical Functions. (2012). *Trans Cranial Technologies Ltd.* (n.d.). Retrieved April 8, 2014 from http://www.trans-cranial.com/local/manuals/cortical_functions_ref_v1_0_pdf.pdf
- De Bruin E. A., Rowson M.J., Van Buren L., Rycroft J. A. and Owen G.N. (2011). Black tea improves attention and self-reported alertness. *Appetite*, 56(2): 235-340
- Huang T.L. and Charyton C. (2008). A comprehensive review of physiological effects of brainwave entrainment. *Alternative Therapies Health*, Sep/Oct 14(5): 38-50.
- Khan N. and Mukhtar H. (2007). Tea polyphenols for health promotion. *Life science*, 81: 519-533.
- Pinto, M. S. (2013). Tea: A new perspective on health benefits. *Food research International*, 53(2), pp558 – 567.
- Ruxton C.H.S. (2009). The health effect of black tea and flavonoids. *Nutrition and Food Science*, 39(3): 283-294.
- Raksha Anand, Sandra B Chapman, Audette Rackley, Jennifer Zientz (2011). Brain Health Fitness: Beyond retirement. *Educational Gerontology*, 37: 450-465.
- Sharangi A.B. (2009). Medicinal and therapeutic potentialities of tea (*Camillia sinensis L.*): A review. *Food Research International*, 42: 529-535.
- Sittiprapaporn W. (2013). Neurofeedback: Use technology to shape the mind. In short term program, July 13 – 14, 2013, School of Anti-Aging and Regenerative Medicine, Mae Fah Luang University, Bangkok, Thailand.