THE STUDY OF BRAINWAVE AND ATTENTIVE PROCESS IN CUMULATIVE DRINKING BLACK TEA

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MASTER OF SCIENCE
IN
ANTI-AGING AND REGENERATIVE SCIENCE

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ABSTRACT

This independent study was intended to study the brainwave and attentive process in cumulative drinking of black tea. The black tea used in this study is named Tea Phanna and was granted from SriNapan-Tawane Community, Nan province. 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/Black Tea

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ABBREVIATIONS AND SYMBOLS

n	=	Number of sample population
$\overline{X}$	=	Mean of sample population
SD	=	Standard deviation of sample population
t	=	The statistical test to compare mean of 2 groups (t-test)
F	=	The statistical test to compare mean more than 2 groups (F-test)
Sig.	=	Statistic significant
H_0	=	Null hypothesis
H_1	=	Alternative hypothesis
.*	=	$p< 0.05$
.**	=	$p< 0.01$
.***	=	$p< 0.001$

CHAPTER 1

INTRODUCTION

1.1 Background and Reason

One of the greatest accomplishments of the 20th century is the doubling of human lifespan. This has brought issue to brain health to the forefront of health care nowadays. Clone and manufactured body parts, gene therapies, nano technology and miracle drugs promise a 100-year average life span, studies show that 40 percent of those reaching age 85 and nearly 100 percent of those reaching 100 will be senile. So what benefits is living longer, if we can't enjoy restored bodies or even know that we are alive?. (Eric, 2005, p.56) This aspect of health corresponds to an Anti-aging and Regenerative concept. 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 (Anand, Bhatt, Varghese & Das, 2011).

There are a lot of measurements which can measure brain activity such as attention test, stress test, neuropsychological test or Magnetic Resonance Imaging (MRI). One of the most used of brain measurements is Electroencephalogramme (EEG). 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, Watt, . & Bajaj, 2012). Each type of brainwave could be affected by nutrients or substances from foods or beverages (de Jager & 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 & 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 & 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 Fredhlom (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.

1.2 Objectives

1.2.1 To investigate attentive process in cumulative drinking of black tea.

1.2.2 To investigate brainwave in cumulative drinking of black tea.

1.3 Importance of the Study

1.3.1 To enhance understanding of the attentive process in cumulative drinking of black tea that could promote cognitive learning.

1.3.2 To enhance understanding brainwaves in cumulative drinking of black tea that could be promote longevity and health.

1.4 Hypotheses

1.4.1 Cumulative drinking of black tea could increase attentive process.

1.4.2 Cumulative drinking of black tea could change frequency and spectrum of brainwaves.

1.5 Conceptual Framework

This study will study only brainwaves and attention which could be affected by black tea in working people. The brainwaves and attention will be studied in the period of eyes closed, eyes open and doing spatial test. In order to find the answer of hypothesis, the framework is set as asking the participants to do eyes closed, eyes open and doing spatial test in the time 0, 10, 20 and 30 minutes. The participants will drink tea after doing spatial test in time 0 minutes and drink every 10 minutes until 30 minutes. Along with doing eyes closed, eye open and doing spatial test (before and after drinking black tea), the brain wave was recorded.

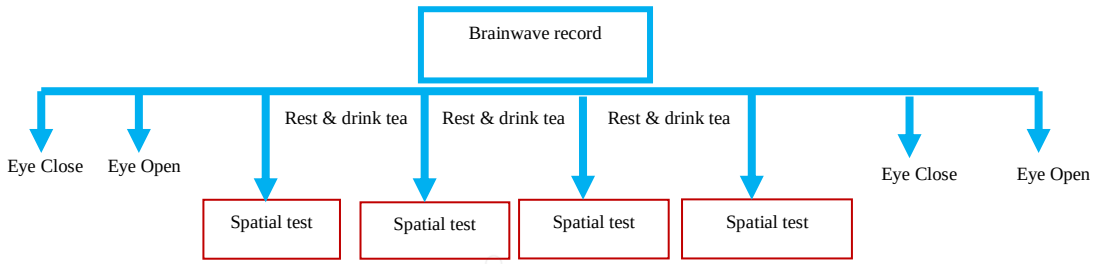


Figure 1.1 Conceptual Framework

1.6 Expected Benefits

1.6.1 To understand more attentive process in cumulative drinking of black tea. This effect could be used to explain benefit of black tea in people who drink black tea.

1.6.2 To understand more the effects of black tea on brainwaves in people who drink black tea.

1.7 Scope of Independent Study

The study was conducted by culmulative drinking black tea and doing spatial task experiment. All of the participants were 21-60 year-old Thais.

1.8 Agreement in the Independent Study

1.8.1 This independent study had studied only brainwave and attentive process in people who drink black tea as cumulation.

1.8.2 The method of this study was followed by neurological methodology.

1.8.3 All of the participants accepted all of the conditions in the study and were selected as inclusion criteria. They all to signed a consent form.

1.9 Limitation on the Independent Study

The way to study brainwaves in humans is to record brain electricity from equipment. In this study, Brain Actor 2 channel has been used to record. It has limitations on detection of electricity from all over the scalp because it can detect in only 2 positions. Therefore, the researcher has to scope position to place the electrode on the scalp that is related to the spatial test in order to study the effect.

1.10 Operational Definition

With the reference of www.thefreedictionary.com, the operational definitions are provided below:

1.10.1 Brainwave (Neurophysiology) is rapid fluctuations of voltage between parts of the cerebral cortex that is detectable with an electroencephalograph. In this study, the research will study mainly in 4 brainwaves.

1.10.2 Beta wave is the normal brainwave in the encephalogram of a person who is awake and alert; occurs with a frequency between 13 and 30 hertz.

1.10.3 Alpha wave is the normal brainwave in the electroencephalogram of a person who is awake but relaxed; occurs with a frequency of 8 -12 hertz.

1.10.4 Theta wave is the normal brainwave in the encephalogram of a person who is awake but relaxed and drowsy; occurs with low frequency and low amplitude at 4-7 hertz.

1.10.5 Delta wave is the normal brainwave in the encephalogram of a person in deep dreamless sleep; occurs with high voltage and low frequency (1 to 4 hertz).

1.10.6 Spectrum is the whole range of electromagnetic radiation with respect to its wavelength or frequency. In this study, spectrum is the highest amplitude of brainwave

in each frequency band. The way to calculate spectrum of each frequency is shown in chapter 3.

1.10.7 Attention (Psychology) the act of concentrating on any one of a set of objects or thoughts.

1.10.8 Black tea is a dark tea prepared from fresh tea leaves that have been fully fermented before being dried. In this study, black tea is specific to Sripanna-Tea, the tea in a Royal project that is soled in Phufa shops.

CHAPTER 2

LITERATURE REVIEW

2.1 General Definition

Brainwave with the reference to neurological term brainwave means rapid fluctuations of voltage between parts of the cerebral cortex that is detectable with an electroencephalograph, nevertheless, in literature of Eric R Braverman, MD, also definite brainwave as brain electrical activity (Eric, 2005)

2.1.1 Beta brainwave is the first kind of brainwave that Hans Berger discovered. He defined frequency around 13-30 hertz as beta wave. This kind of wave shows a thinking and focus state (Huang & Charyton, 2008).

2.1.2 Alpha brainwave is another kind of brainwave that Hans Berger discovered. He defined frequency around 8-12 hertz as alpha wave. This kind of wave represents as calm and peaceful yet alert state (Huang & Charyton, 2008).

2.1.3 Theta brainwave is the normal brainwave in the encephalogram of a person who is awake but relaxed and drowsy; occurs with low frequency and low amplitude at 4-7 hertz (“Theta brainwave”, n.d.)

2.1.4 Delta brainwave is the normal brainwave in the encephalogram of a person in deep dreamless sleep; occurs with high voltage and low frequency (0.5 to 3 hertz) (“Delta brainwave”, n.d.)

2.1.5 Spectrum is the whole range of electromagnetic radiation with respect to its wavelength or frequency (“Spectrum”, n.d.)

2.1.6 Attention in the term of Psychology, attention is the act of concentrating on any one of a set of objects or thoughts ("Attention", n.d.)

2.1.7 Black tea is tea (*Camillia sinensis*) prepared by full fermentation which contains organoleptic taste and chemical contents (Sharangi, 2009).

2.2 Literature Review

2.2.1 Brain and brainwave

The brain is a unique organ of the body. While it constitutes only 2% of body weight, it receives 20-25% of the cardiac output, consumes 20% of oxygen and glucose supplies, utilizes 50% of overall gene pool and has number of neurones like the stars in the sky. This amazing complex structure is also the greatest generator of electrical energy. The brain is a unique organ with structured laterality, with the left hemisphere responsible mainly for language and logistic skills and the right hemisphere initiates the emotions of pleasure, relaxation, meditation and sexual orgasm and is dominant in taking the individual to a higher level of consciousness, connecting with space as a step towards further relationship with all the dimensions of the universe. While the left cerebral hemisphere is predominantly concerned with logical, verbal, analytical and calculative aspects of human intelligence, the right hemisphere deals with the imaginative, emotional, artistic and visuospatial traits. The wonderful synergy between the functions of the right and left sides of sthe brain provides a huge resource for potentially beneficial connections (Panagariya, 2011).

The brain is the organ which is connected with a complex of 1 trillion neurons. Every neuron communicates to each other via neurotransmitters. Each neurotransmitter can be determined by a brainwave which is connected to overall health benefits and personality. There are hundreds of neurohormones, neuropeptides and neuromodulators but a few among them are most important and well-studie as below (Palangariya, 2011)

2.2.1.1 Beta wave is 15-35 Hz frequency. The wave corresponds to dopamine which is established by Frontal lobe (Braverman et al., 2012). Betawave can be divided into 2 types

1. Beta wave. The frequency is 15-22 Hz. The wave relates to characteristics of thinking, focus, sustained attention, problem-solving, and externally oriented. If the brain expressed too high a betawave in the left-hemisphere, it could lead to depression. But if it is Right Hyper-activation, it means anxiety. Besides, too high a betawave still relates to anxiety disorder, obsessive compulsive disorder and sleep disorders (Sittiprapaporn, 2013)

2. High Beta wave. The frequency is 23-35 Hz. This wave relates to hyper-vigilance, very fast cognitive processing. Too high a High beta wave could relate to epilepsy auras, cortical irritability, hyper-vigilance, overthinking, ruminations, obsessive compulsive disorder (Sittiprapaporn, 2013)

2.2.1.2 Alpha wave. The frequency is 8-12 Hz. This wave powered by Acetylcholine which is established in Parietal lobe (Braverman et al., 2012). Alpha wave characterizes to speed of processing due to the function of acetylcholine on memory storage and processing (Braverman et al., 2012). It relates to the characteristic of alertness, peacefulness and meditation. High amplitude alpha wave in frontal lobe besides, it could be found in day dreamers, ADD/ADHD, depression, traumatic brain injuries and marijuana user. Too high an alpha wave in posterior, even rarely found, relates to anxiety and insomnia (Sittiprapaporn, 2013).

2.2.1.3 Theta wave. The frequency is 5 – 7 Hz. It corresponds to γ-amino butyric acid (GABA) which is established in the Temperal lobe. Temperal lobe is also reponsive to generate a natural analgesic, tranquilizing and calming response in the mind. Theta wave relates to rhythm of brain. Rhythm is the ability of the brain to get as much of its parts firing together (what it sees and hears) in an orderly way (Braverman et al., 2012). Theta wave still relates to Trance state, Creativity, Intuition, Internal focus, thought in Theta are visual/emotion. High amplitude of Theta relates to Learning disability such as Foggy brains, Filtering problem (ADHD) and Processing problem (ADD), Slow reaction time, Lack of oxygen and blood flow, Depression and Anxiety (Sittiprapaporn, 2013).

2.2.1.4 Delta wave. The frequency is 0.5 – 3 Hz. Delta wave corresponds to Serotonin which is established by Occipital lobe. Sertotonin coordinates to

synchrony, the ability of both sides of the brain. Delta wave relates to sleep state, Regenerative state, Complex problem solving, Consciousness completely internalized and Transcendental state (Braverman et al., 2012). This is the wave dominant in infants up to 6 months (40% of the amplitude in infants and <5% of the amplitude in a "normal" adult. High amplitude of Delta corresponds to learning disability-sleep brain, Brain injuries, Eye blinks and eye movement artifact (Sittiprapaporn, 2013).

2.2.2 The assessment of brainwave

Psychological health is intricately connected to physiological health. Each brain bioelectrical function is related to a specific lobe of the brain and diminished levels of each result in specific physical and psychological complaints and tests and multi-modal treatments for effective reversal (Braverman et al., 2012).

2.2.2.1 Beta wave is related to brain energy or power. Beta wave has close relations with dopamine which is synthesized from the frontal lobe. Chief complaints of low betawave are related to loss of energy and include: fatique, pallor, diarrhea, lightheadness, decreased libido, sexual dysfunction, routine-task difficult, decreased physical activity, thoughts of self-destruction (Braverman et al., 2012).

2.2.2.2 Alpha wave is related to memory or cognitive. Alpha wave has close relations with acetylcholine which is synthesized by parietal lobe. Chief complaints of low alpha wave are related to loss of brain quickness: dry mouth, dry cough, difficulty concentrating and memory lapses (Braverman et al., 2012).

2.2.2.3 Theta wave is related to brain calmness or stability. Theta wave has close relations with GABA which is synthesized from the temporal lobe. Chief complaints of low Theta wave are related to loss of wave parity and include: trembling, twitching, hyperventilation, flushing, tachycardia, palpitations, sweating, cold or clammy hands, paresthesia, chest pain or discomfort, restlessness, blurred vision, tinnitus, feeling of dread, abnormal sense of smell, abnormal odors, lump in throat, butterflies in stomach, unusual allergies, rage, temper, and fear of dying (Braverman et al., 2012).

2.2.2.4 Delta wave is related to brain balance or resting. Delta wave has closely relation with serotonin which is synthesized from the occipital lobe. Chief complaints relate to loss of left-right symmetry include: backache, headache,

shortness of breath, choking, PMS, hypervigilance, sleep disorders, depersonalization or derealization, social phobias and strange thought patterns (Braverman et al., 2012).

2.2.3 Overview of Black Tea.

Tea is the one of the most widely consumed beverages in the world and oldest, being referred in the literature as one of the best sources of phenolic compounds and has attracted much attention in recent years due to its antioxidant capacity. In general, tea is taken after infusion with water which contributes to the extraction of phenolic compounds, which are considered beneficial to human health. The major constituents of tea polyphenols are catechins with a structure of flavan-3-ol and their polymerized products (Pinto, 2013). In oolong (which is partially fermented), black tea (which is fully fermented), most of catechins are oxidized and polymerized by enzymes derived from tea leaves during the fermentation process. The compounds such as Theflavin, Thearubigins, Theophylline, Theobromine, Theanin, Flavonoids and Caffeines, can be found in black tea (Khan & Muktar, 2007; Ruxton, 2009). The amount of compounds in black tea after infusion can be found from the table 2.1.

Table 2.1 The compositions of black tea

	Rang (mg per 100 ml as consumed)
Epicatechin	0.48 – 8.74
Epigallocatechin	0.29 – 31.04
Catechin	0.35 – 4.79
Gallocatechin	0.56 – 2.78
Theaflavins	0.36 – 5.27
Kaemferol	0.25 – 2.41
Myricetin	0.17 – 0.90
Quercetin	0.41 – 4.75

Table 2.1 (Continued)

	Rang (mg per 100 ml as consumed)
Thearubigins	35.2 – 72.5
Caffeine	< 1 – 39

Source Ruxton (2009)

2.2.4 Black tea and brain function

Brain has important role for our health, espectially, longevity health. Black tea is one of the herbs that may promote longevity health. There are many studies to show the promotion of health as below.

2.2.4.1 Black tea and attention

According to the fermentation of tea, caffeine is produced by oxidation of some flavonoids in green tea. Drinking black tea could increase attention and performance of working. Tea consumption would have a greater positive relationship with work related outcomes than consumption of other beverages (Bryan et al., 2012). In the study of De Bruin, Rowson, Van Buren, Rycroft & Owen (2011), they investigated whether tea improves attention and self-reported alertness in two doubleblind, randomised, placebo-controlled, crossover studies. Participants received black tea (made from commercially available tea bags) in one condition and placebo tea (hot water with food colours and flavours) similar in taste and appearance to real tea in the other condition. Attention was measured objectively with attention tests (the switch task and the intersensory-attention test) and subjectively with a self-report questionnaire (Bond–Lader visual analogue scales). In both studies, black tea significantly enhanced accuracy on the switch task (study 1 $p < .002$, study 2 $p = .007$) and self-reported alertness on the Bond–Lader questionnaire (study 1 $p < .001$, study 2 $p = .021$). The first study also demonstrated better auditory ($p < .001$) and visual ($p = .030$) intersensory attention after black tea compared to placebo. Simulation of theanine and caffeine plasma time–concentration curves indicated higher levels in the

first study compared to the second, which supports the finding that tea effects on attention were strongest in the first study. Being the second most widely consumed beverage in the world after water, tea is a relevant contributor to our daily cognitive functioning (Bruin et al., 2011).

2.2.4.2 Black tea and cognitive function

Tea is of relevance to cognitive function because it contains biologically active constituents such as caffeine, theophylline, theobromine, theanine and flavonoids. A review by Ruxton (2009) summarised 23 studies on the impact of caffeine on cognitive function finding positive effects on mood, alertness and mental performance at acute intakes of 37.5-450 mg. Caffeine is known to inhibit neurotransmitters that slow down brain activity and influence others that alter mental performance e.g. noradrenaline, dopamine and serotonin (Fredholm, Bättig, Holmén, Nehlig & Zvartau, 1999). The evidence for flavonoids is still emerging and may relate to the anti-ischaemic properties of L-theanine which promotes blood flow in the brain (Ruxton, 2009).

2.2.4.3 Black tea and Parkinson's disease

Parkinson's disease is chronic, progressive neurodegenerative disorder characterized by motor impairment and loss of dopaminergic neurons in the substantia nigra and a massive reduction in striatial dopamine. In the study of A. Anand et al. (2012) showed that Theaflavin attenuated MPTP/p induced apoptosis and neurodegeneration as evidenced by increased expression of nigral tyrosine hydroxylase (TH), dopamine transporter (DAT) and reduced apoptotic markers such as caspase-3, 8, 9. This data indicated that theaflavin may provide a valuable therapeutic strategy for the treatment of progressive neurodegenerative diseases such as PD. The study has been investigated in PD induced mice (Ruxton, 2009).

It's not only the study in mice, but the studies in humans as well. The study of Hu et al, 2007 followed up over 29,000 Finnish adults from 13 years to establish a case control scenario. Subjects who drank three or more cups of tea per day were significantly less likely to develop PD. Similar finding were found by Tan, Lyulcheva, Dean & Bennett (2008), in a perspective cohort of 63,000 Chinese adults which also reported an inverse association between caffeine intake and PD risk

(although the link with tea was independent of caffeine suggesting that other mechanism were at work) (Ruxton, 2009).

2.2.4.4 Black tea and Alzheimer's disease.

Alzheimer's disease is one of the neurogenerative diseases resulting from a deficiency of Cholinergic function such as cholinergic receptor and prolonging of the availability of acetylcholine released into the neuronal synaptic. Black tea has acetylcholinesterase inhibition effect; this could be result from Theaflavins, Thearubigins and other flavonoids (Anand et al., 2011; Ray & De, 2013).

2.2.5 Toxicology of Black Tea and optimal dose

Black tea has been reported to possess a high concentration of tannins that is about 0.8 mg/ml. The presence of tannins contribute to inhibit absorption of non-heam iron to a significant extent by forming insoluble complexes with the ferric iron and subsequently affecting iron absorption in the lumen (Jain, Manghani, Kohli, Nigam, & Rani, 2013). The phenolic compounds presented in tea may also cause precipitation of digestive enzyme of the gut and hence inhibit them. Black tea is also known to affect some intestinal microfloras that contribute to health by metabolizing pro-carcinogens and nutrients that reach the colon. It significantly reduces the amount of bacteria present in the intestine which may have health benefit. Although, the anti-carcinogenic effects of black tea have been reported, black tea consumption may also show carcinogenic effects on selected organs like the rectum. Tea bags have been known to have high fluoride content in the range of 1.15-4.0 mg/L. According to an American Dietary Reference Intake (DRI) is 1.5-4.0 mg for adult and 2.5 mg for children. Thus 4 cups of black tea are safe if each tea bag is assumed to contain 2 grammes of tea (Jain et al., 2013).

While studies on cardiovascular disease and cancer point to a significant benefit in excess of 2-3 cups of tea per day, some concerns have been expressed about tea, as a caffeine drink. The effect of hydration and sleep has been examined by Ruxton (Ruxton, 2009). He reviewed eight intervention studies looking at hydration status following explosure to caffeine pills. In five of these, following intakes of around 98-420 mg per day, no significant impact on hydration was observed. In the three studies where hydration was adversely affected, caffeine intakes tended to be in

the region of 600 mg per day. Ruxton (2009) also considered whether caffeine consumption adversely affected sleep quality or blood pressure, finding that problems were rare at intakes below 500 mg per day. No adverse effects were seen with typical tea consumption. In the review of C. Ruxton suggested that the optimal range of tea consumption is 1-8 cups per day (up to 5 or 6 mugs) which could contain sufficient active constituents, e.g. flavonoids, to increase the likelihood of health benefits without exceeding daily caffeine intake of 400 mg (Ruxton, 2009).

2.2.6 Electroencephalographic recording

2.2.6.1 Overview of electroencephalography

The discovery of electroencephalography (EEG) in 1929 by the German psychiatrist, Hans Berger was a historical breakthrough providing a new neurologic and psychiatric diagnostic tool at the time, especially, considering the lack of all those now available in daily practice (EP, CT, MRI, DSA etc.) without which the making of neurologic diagnosis and planning neurological operative procedures would be now unconceivable. EEG revolutionized daily neurologic and neurosurgic procedures, and bridged a time period of about 40 years (1930-1970) until the advent of computer tomography. Nowadays its importance is not as great as it was before, but it still has its place in the diagnostic work-up of seizures, brain tumors, degenerative brain changes, and other diseases (Kennett, 2012).

The encephalogramme in medical areas is mostly recorded from the scalp; therefore, we could record only the brain electricity which can pass through scalp. Brain electricity, mostly, is formed around the dendrite area. This formation of brain electricity makes excitatory & inhibitory postsynaptic potential (EPSP & IPSP) on the cortex, mostly. This action is mostly not from action potential due to its origin. Action potential originates deep in the brain. That means the signal is very tiny. Besides, the occuring time is very small, around a millisecond. That is why we cannot detect signal of action potential on the cortex. On the other hand, EPSP & IPSP expand the signals in the level of the dendrite, which is shallower. In conclusion, EEG detection is the monitoring of signals from the dendrite area (Srikijvilaikul et al., 2006).

Electroencephalographic recording is the way to diagnose brain function. The diagnosis is interpreted by the changing of EEG. The source of the

electroencephalogramme is recorded from scalp. There are many systems of electroencephalography recorder. In this study, Brain Actor 2 channels EEG has been selected to record the changing of EEG of parpticipants with Learnmon programme to help analysis of amplitude, recording and time scaling.

2.2.6.2 Electrodes

This is one of the most important tools to record brain electricity. Accordingly, units of brain electricity are in microvolts (μV), the signal is very small, thus the electode has to conduct a good signal. There are 2 types of electrodes, Surface electrode and subdermal dural electrode (Paramee, 2013). In this study, surface electrodes were selected to use to detect and record EEG.

Surface electrodes made of pure metal and named as Gold surface electrode, Silver surface electrode etc. The shape of electrode is a cup or a disc electrode. According to the electrode's is metal, it can increase electrical resistance between scalp and electrode. The recommendation is to use electode gel to help electric conductivity (Paramee, 2013)

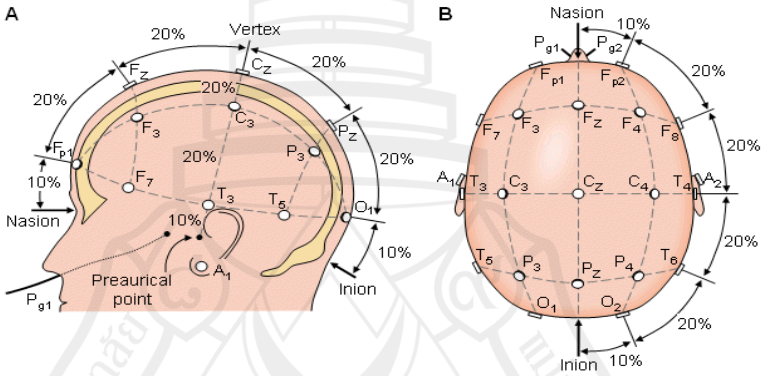
2.2.6.3 International 10-20 system of electrode placement

The way to place the electrodes was first presented in 1947 at The international Congress of Electroencephalography and Clinical Neurophysiology at London, England. Later, H. Jasper, the neurologist from Montreal Neurological Institute, was assigned to study this issue. The study covered the way to use in Europe and North America. It was found that there are a variety of ways such as R. Schwab and Abbort from Massachusetts General Hospital, the system of F. Gibbs from Chicago and system of Cobb from the National Hospital for Neurologic Disorders, Queen's Square, London. After that study, the new agreement of placing the electrode was presented in 1958 called "The ten-twenty system" from the agreement of "The International Federation of Societies for EEG and Clinical Neurophysiology". (Paramee, 2013).

The 10-20 system or The Internaltional 10-20 System of Electrode Placement is the way to place the EEG electrode on scalp followed "The International of Societies for EEG and Clinical Neurophysiology" by the concept of Bony landmark in order to table the scalp to 10% and 20% for placing electrodes (Paramee, 2013).

In order to place electrodes in the right position and so that brain electricity can be recorded; the way is to start from main 3 positions on the scalp bone. The details are as follows.

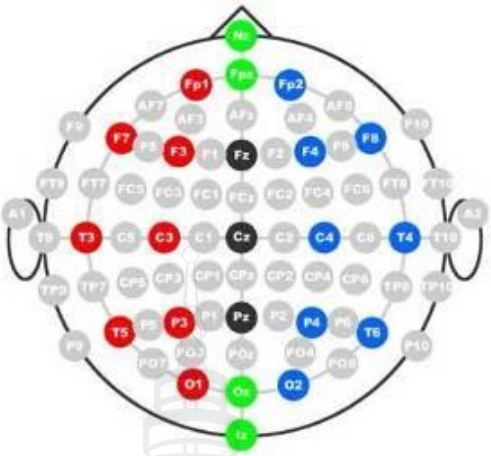
Inion is the bump at the back of the skull. Nasion is a point between upper nose and forehead. Preauricular point is a point of the posterior root of the zygomatic arch lying immediately in front of the upper end of the tragus (Brain Master Technologies, Inc, n.d; Medical Dictionary, Medical Terminology, n.d.). All of the positions are shown in the figure 2.1.



Source Electroencephalography (1992)

Figure 2.1 Picture shows 3 main positions that are used to determine electrode position according to 10-20 system

Each site has the letter to identify the lobe and number or another letter to identify the hemisphere location. The letters used are “F-Frontal Lobe, “T”-Temperal Lobe, “C”-Central Lobe, “P”-Parietal Lobe, “O”-Occipital Lobe. (Note: There is no central lobe in the cerebral cortex. “C” is just used for identification purpose only.) Even numbers refer to the right hemisphere and odd numbers refer to the left hemisphere. “z” refers to an electrode placed on the mid line. The smaller number the closer the position to the mid line. “Fp” stands for Front polar. (Brain Master Technologies, Inc, n.d.).



Source Cortical Functions (2012)

Figure 2.2 10-20 system electrode position

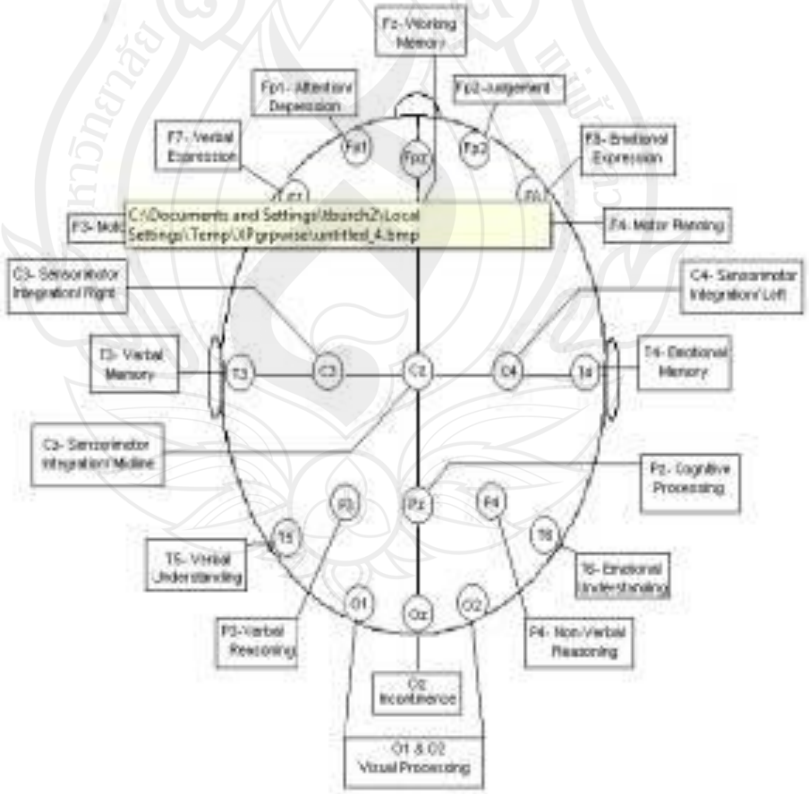


Figure 2.3 Relation of 10-20 electrode position and function

2.2.6.4 Brain Actor information

Brain Actor 2 channels EEG is a device to record and analyse brain frequencies on 2 channels. Along with this extensive analysis and training software, it offers many different applications in the areas of research, therapy and potential development. In addition to the classic range of EEG feedback training (Neurofeedback) the BrainActor is especially useful for the analysis and evaluation of audiovisual stimulation through Cybernetics effect efficiency. In this sense, the BrainActor to each mindmachine represents a useful supplement when regularly scheduled for objective feedback on the effect of mindmachine sessions. (Brain Actor 2-channels EEG, n.d.)

The BrainActor can be used with any standard PC (486) and MS Windows as the operating system. The high quality of the modular software, as well as the graphical elements makes it very easy operation. The connection cable to the PC provides a galvanic separation through an optical transmission path (glass fibre). The voltage supply via 4 Mignon batteries or rechargeable batteries and therefore influenced not the measurement results. It was developed to use in practice, as well as a high reliability in the foreground.All necessary electrodes as well as the software with extensive analysis tools are included. The electrodes can be reordered at any time (Brain Actor 2-channels EEG, n.d.)

Figure 2.4 Brain Actor

2.2.6.5 Learnmon programme software information

Learnmon Programme is software that offers a variety of analysis tools: real-time display during recording, amplitude and time scaling, no time limit with respect to the recording time, digital filter for each channel (as well as an editor for

your own filter definitions), recording of keyboard markers... and much more. It runs from 486 PC with 100 MHz and win 3.1. The data can be also exported as ASCII files for use in other databases or statistikprogramen. All graphics can be printed out. (Brain Actor 2-channels EEG, n.d.)

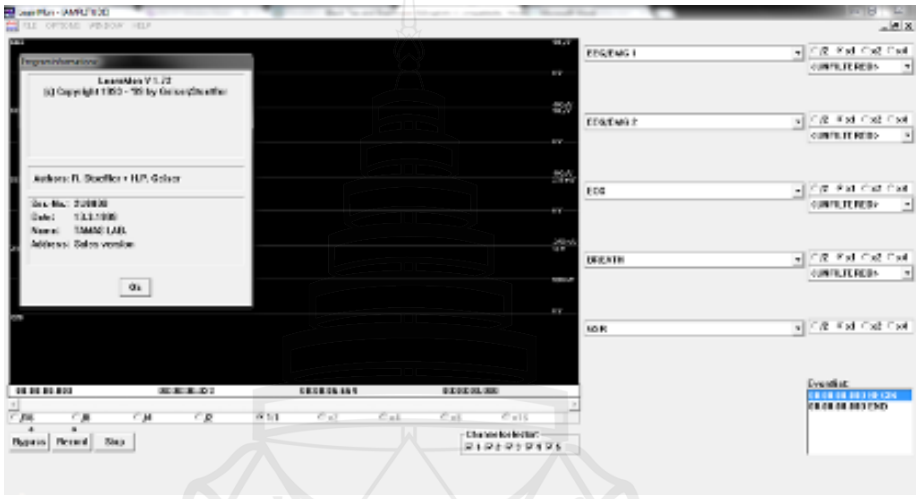


Figure 2.5 Page of Learnmon Programme In this programme. It provides analysis tools as follow

1. Real Time Window

Real time display during recording (amplitude and time Division); Limit the recording time only by hard drive capacity; digital filter for each channel (your own filters can be defined). (Brain Actor 2-channels EEG, n.d.)

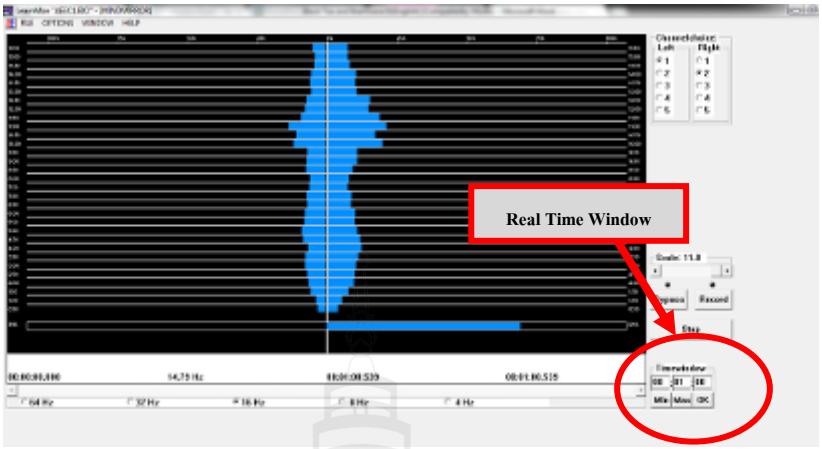


Figure 2.6 Real time window

2. The 3D-Landscape-Darstellung

The spectral analysis of brain waves for measurement over a certain time period allows: three-dimensional representation of frequencies in the course of time, channels are digital miscible, representation of the 3 D landscape is variable. (Brain Actor 2-channels EEG, n.d.)

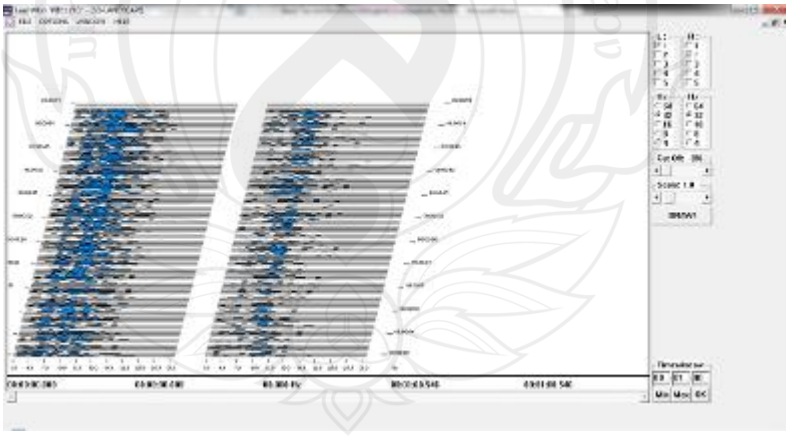


Figure 2.7 3D-Landscape-Darstellung

3. The Mindmirror

A snapshot shows the brain activity at any given time- or a representation of the average brain activity on the different frequency values related to a period: real time frequency analysis by fast Fourier transform in five different resolutions of the bandwidth. (Brain Actor 2-channels EEG, n.d.)

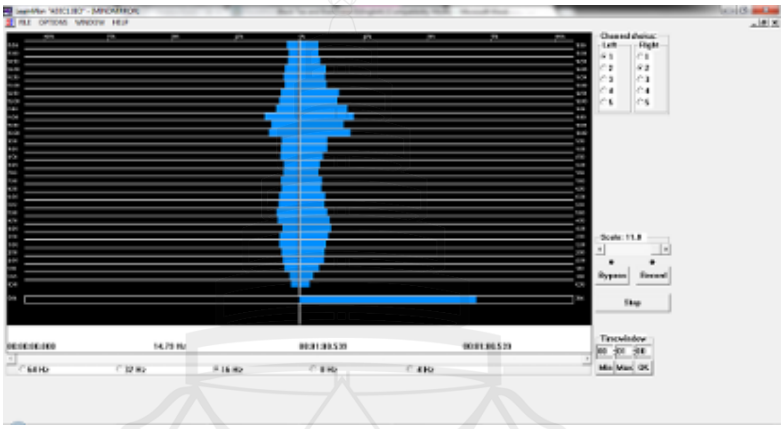


Figure 2.8 Mindmirror

4. Mindball with audio feedback

Easy-to-use feedback and training module. You can control the small ball in the middle of the screen with your brain activity. (Brain Actor 2-channels EEG, n.d.)

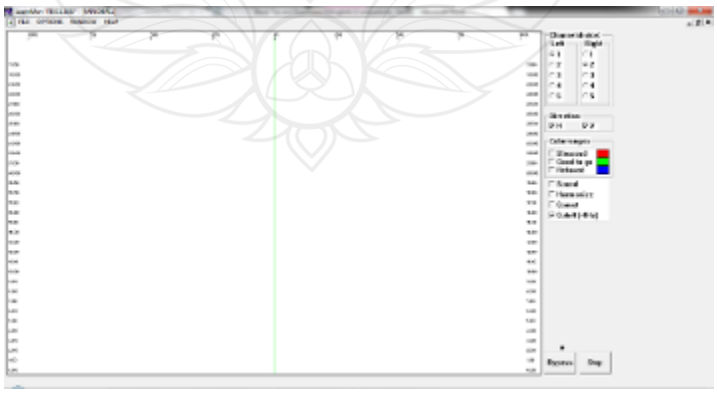


Figure 2.9 Mindball with audio feedback

5. Text info

Here you can show all relevant information of a measurement entries such as information about the subjects, have their own names for the individual channels and endorsements to the measuring procedure. (Brain Actor 2-channels EEG, n.d.)

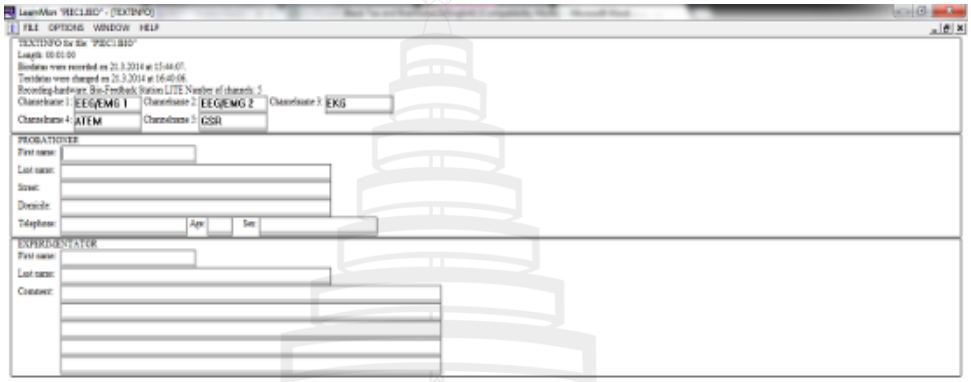


Figure 2.10 Text Info

6. Activity

The activity shows the chronological sequence of the strength of any frequencies. Overlooking the whole measurement with its absolute or relative frequency activity at a glance with this module. (Brain Actor 2-channels EEG, n.d.)

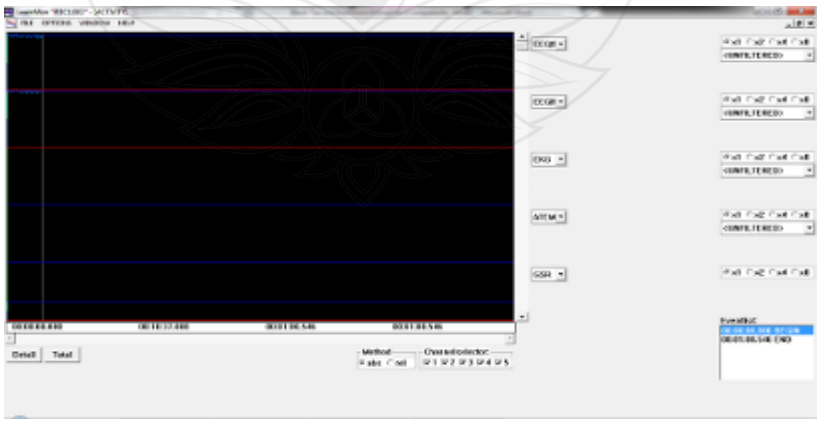


Figure 2.11 Activity page

7. Fraction dimension

Calculate the fractal dimension of the amplitude data and record them. An excellent tool to visualize the amount of chaos of the EEG data. (Brain Actor 2-channels EEG, n.d.)

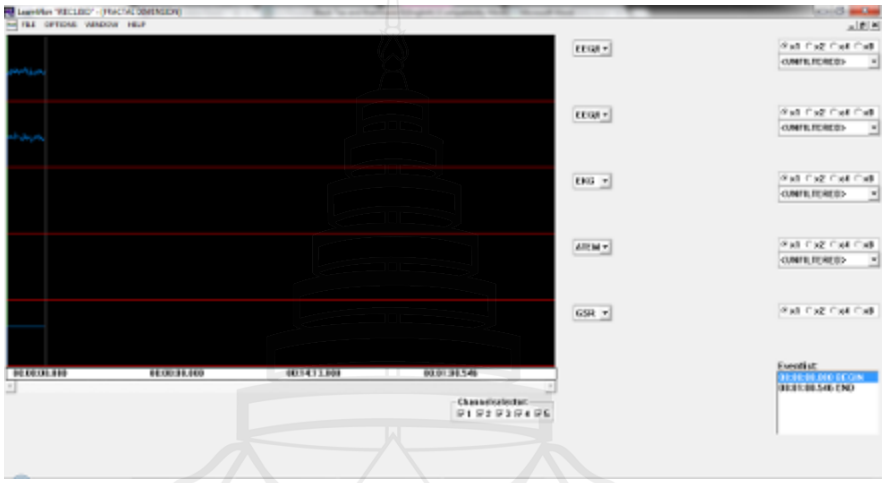


Figure 2.12 Fracment page

2.3 Influence Factors in the Independent Study

2.3.1 Dependent Variable: Black Tea

2.3.2 Independent Variable: Reaction time, numbers of correct answers and Changing of brainwaves.

2.3.3 Control Variable: Caffeine.

2.4 Related Research

2.4.1 Black Tea and Attention

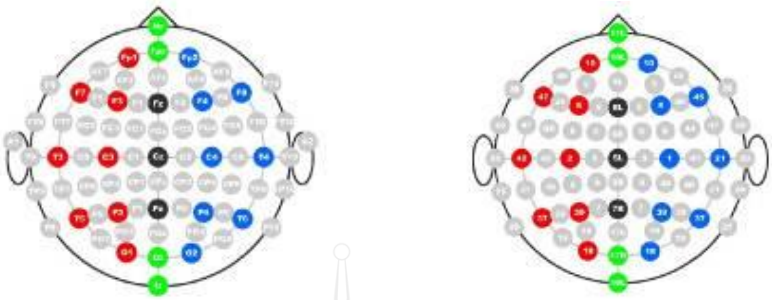
According to the fermentation of tea, caffeine is produced by oxidation of some flavonoids in green tea. Drinking black tea could increase attention and

performance of working. Tea consumption would have a greater positive relationship with work related outcomes than consumption of other beverages (Bryan et al., 2012). In the study of De Bruin et al. (2011), they investigated whether tea improves attention and self-reported alertness in two doubleblind, randomised, placebo-controlled,crossover studies. Participants received black tea (made from commercially available tea bags) in one condition and placebo tea (hot water with food colours and flavours) similar in taste and appearance to real tea in the other condition. Attention was measured objectively with attention tests (the switch task and the intersensory-attention test) and subjectively with a self-report questionnaire (Bond–Lader visual analogue scales). In both studies, black tea significantly enhanced accuracy on the switch task (study 1 $p < .002$, study 2 $p = .007$) and self-reported alertness on the Bond–Lader questionnaire (study 1 $p < .001$, study 2 $p = .021$). The first study also demonstrated better auditory ($p < .001$) and visual ($p = .030$) intersensory attention after black tea compared to placebo. Simulation of theanine and caffeine plasma time–concentration curves indicated higher levels in the first study compared to the second, which supports the finding that tea effects on attention were strongest in the first study. Being the second most widely consumed beverage in the world after water, tea is a relevant contributor to our daily cognitive functioning (De ByuBruin et al., 2011).

2.4.2 Broadmann and electrode maps

Broadmann areas were originally defined and numbered by German anatomist, Korbinian Broadmann based on the cytoarchitectural organization of neurons he observed in the cerebral cortex. Broadmann published his maps of cortical areas in 1909.

From the beginning it was assumed that different structure served different functions, the areas have been discussed, debated, refined, and renamed exhaustively for near a century and remain the most widely known and frequently cited cytoarchitectural organization of human cortex. A cross reference between the 10/10 and 10/20 position and their corresponding closet Broadmann are (Cortical Functions, 2012). A review of all cortical Broadmann area's and their function are presented as below (only the area to use for Brain Actor 2 Channels in this study).



10-20 electrode system Broadmann corresponding area

Source Cortical Functions (2012)

Figure 2.13 Picture of Broadmann area and 10/20 electrode system

2.4.3 Broadmann area 5 Somatosensory Association Cortex

Broadmann area 5 is part of parietal cortex in human brain. It is situated immediately posterior to the primary somato sensory areas. The right secondary sensorimotor cortex is clearly involved in visuospatial processing, including the perception of the personal space and spatial imaginery. The secondary sensorimotor cortex participates in processing too-use-gestures, motor imaginery, bimanual manipulation and similar praxic abilities. Area 5/7 may also participate in a circuit underlying imitation of motor learning. Functional study confirmed that the superior parietal lobe participates in tectile location whereas the inferior parietal lobe is maybe involved in tectile recognition. The superior parietal lobe also seems to participate in other processes, such as rhyme detection and semantic categorization tasks, and interestingly temporal context recognition (Cortical Functions, 2012).

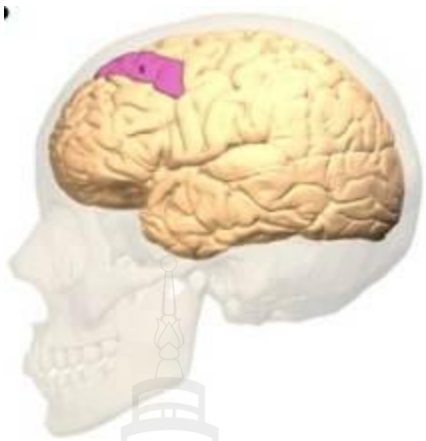
Source Cortical Functions, 2012).

Figure 2.14 Somatosensory Association Cortex

2.4.4 Broadmann area 8 Includes Frontal Eye Fields

It is situated just anterior to the premotor cortex, it is included in frontal eye field. Traditionally, area 8 has been regarded "Frontal Eye Field". However, functional studies report of area 8 in a wide diversity of functions, including motor, language, executive functions, memory and attention. Only 2 studies refer to its being participate to eye movements (Horizontal saccadic eye movement). It's very interesting to note the participation of SMA in motor learning supported by several studies. Usually it is accepted that SMA participate in initiating, maintaining, coordinating, and planning complex sequences of movements performed in the particular order. Stimulation of the left SMA has been related to arrest of speech and its damage to a particular type of language disorder refer as "Aphasia of the SMA" (Cortical Functions, 2012).

The participation of area 8 in executive function (e.g. executive control of behavior, inductive reasoning and planning) seems evidents (Cortical Functions, 2012)



Source Cortical Functions (2012)

Figure 2.15 Area 8-Includes Frontal Eye Field

2.5 Conclusion

According to the information of black tea and brain function, there is a relationship between black tea and brain. All functions on the brain of black tea could assume that black tea could affect brainwaves and attention. In conclusion, the result from methodology of this study could help to understand more about relationships between black tea and brainwaves with attention. According to brainwaves is may be a sign of brain health and relates to longevity and health.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Participants for Independent Study

Number of paricipants were 20 people and followed criteria as follow.

3.1.1 Inclusion criteria

3.1.1.1 Male/Female genders that work and live in urban areas.

3.1.1.2 Age between 21-60 years old

3.1.1.3 Healthy subject. Chronic diseases people were excluded.

3.1.1.4 Abstain caffeine beverages for 24 hours before the intervention.

3.1.1.5 No allergy to caffeine/tea.

3.1.1.5 No drug use.

3.1.1.6 Agree with the consent form.

3.1.2 Exclusion criteria

3.1.2.1 Caffeine/Tea allergy.

3.1.2.2 Chronic diseases such as cardiovascular disease, diabetes, hyperlipidaemia etc.

3.1.2.3 Pregnancy/Lactation.

3.1.3 Discontinuation Criteria

3.1.3.1 Allergy symptom after drinking tea such as tachycardia, nausea.

3.1.3.2 Any adverse effects to the subjects along the experiment.

3.2 Research Tools

In order to find the answer of hypotheses, Attentive process and brainwave, the researcher has used tools as follows.

3.2.1 Electroencephalogram (EEG)

Brain Actors 2 Channels EEG was used to collect brainwaves from participant.

3.2.2 Recording Programme

Learnmon programme version 1.72, copied right 1993 - 99 by Geiser/Stoeffler, was used to record and computed the result from Brain actor 2 channels EEG.

3.2.3 Black Tea

TeaPhanna brand, organic tea, was used in the experiment. All products were granted from SriNapan-Tawane community, Nan province. This product is sold in Phufa shop in the royal patronage of HRH Princess Mahachakri Sirindhorn.

3.2.4 Mechanical Aptitude and Spatial Relations Test

This test was gathered by Joan U Levy Ph.D. and Norman Levy Ph.D. The spatial relation test had been selected to use to measure attentive process. The used test has shown in Appendices

3.3 Data Acquisition

3.3.1 The Changing of Brainwaves Before and After Drinking Black Tea.

Data of brainwaves in this study will be collected as frequency and spectrum of each brainwave band. All of frequency and spectrum were collected from Brain Actor 2 channelts EEG

3.3.1.1 The changing of brainwaves was recorded by Brain Actor 2 channels EEG.

3.3.1.2 The device has 5 electrodes to place on the scalp. According to these 5 electrodes, it was identified by colour of wire. The position to place electrodes followed “The international 10-20 system of electrode placement”.

Black Wire was placed on Fp position.

Figure 3.1 Picture shows Black wire place on Fp position

Yellow wire was placed on Fz position. Brown wire was placed on Cz position.

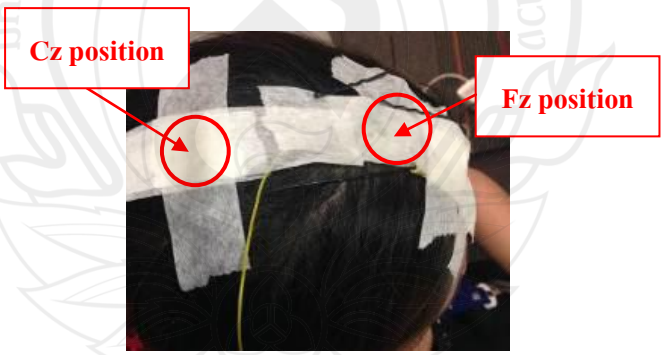


Figure 3.2 Picture shows Yellow wire places on Fz position

Green wire was placed on reference area behind left ring.

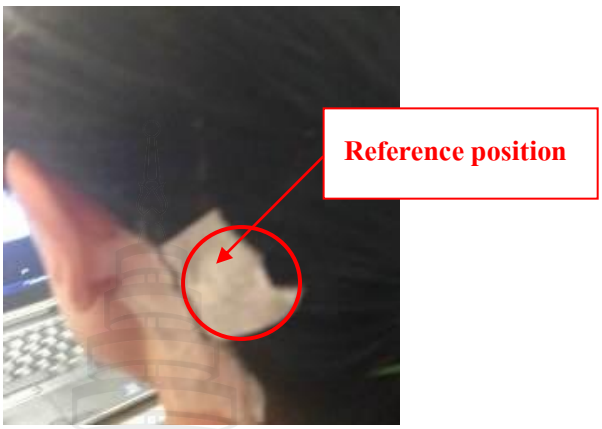


Figure 3.3 Picture show Green wire places on reference area at the bone behind left ring

White wire was placed on reference area behind right ring.

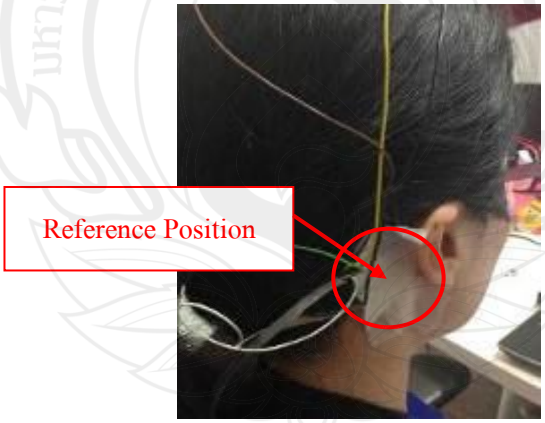


Figure 3.4 Pictures shows Brown wire places on reference position at bone behind right ear

3.3.1.3 The frequency and spectrum of each brainwave will be acquisited from the highest frequency in non screening frequency (2 - 64 Hz), beta wave frequency (13 – 30 Hz), alpha wave frequency (8 -12 Hz), Theta wave frequency (4 – 7 Hz) and Delta wave frequency (0.5 – 3 Hz).

3.3.1.4 Spectrum of highest frequency was calculated by equation as below.

$$\text{Spectrum} = \frac{\text{Length of highest frequency x 100}}{\text{Length of 100\% of frequency*}}$$

*Remark: Length of 100% of frequency depends on the width of computer.

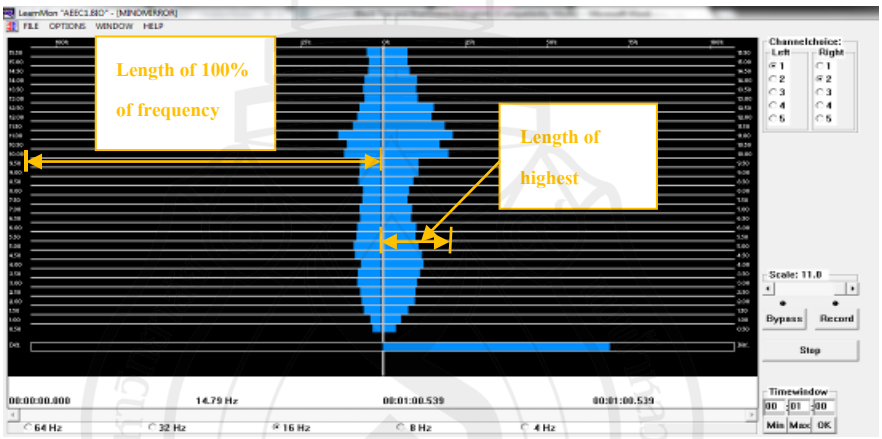


Fig 3.5 Picture shows length of highest and 100% of highest frequency

3.3.1.5 Frequency and spectrum of brainwaves will be collected at 1 minute in eyes closed and 1 minute eyes open period before drinking black tea. The data is also collected during spatial test at 0 without drinking black tea and during spatial time after drinking black tea at 10, 20 and 30 minutes. Finally, the data also will be collected from 1 minute for eyes closed and 1 minute for eyes open period after drinking black tea.

3.3.2 The effect of drinking black tea to attentive processes.

3.3.1.6 The effect of drinking black tea has been measured by Spatial Relationships Test. According to the test, the collected data was reaction time and number of correct answers of doing spatial test.

3.3.1.7 The reaction time was collected from the first question to the eighth question excluding introduction time. All of reaction times were calculated by prolab programme.

3.3.1.8 Number of correct answers of spatial test was collected 4 times in the test. The data acquisition can be shown as diagramme.

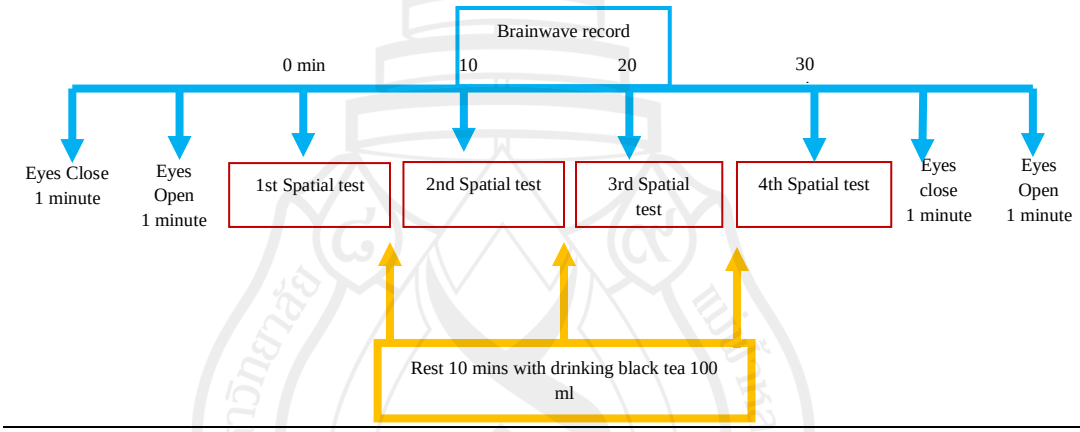


Figure 3.6 Experimental paradigm

3.3.1.9 According to spatial test, Spatial Relationship from Mechanical Aptitude and Spatial Relationships Tests used. The test can be found in Appendix.

3.4 Data Analysis

3.4.1 Attentive process in cumulative drinking black tea.

3.4.1.1 Reaction Time

H_0 = Reaction time of spatial test after drinking black tea is decreased than before drinking black tea.

H_1 = Reaction time of spatial test after drinking black tea is not decreased than before drinking black tea.

In order to prove the hypothesis, the reaction time data will be analysed by pair-t-test and significant at $p<0.05$

3.4.1.2 Number of correct answer

H0 = Number of correct answers of spatial test after drinking black tea is increased more than before drinking black tea.

H1 = Number of correct answers of spatial test after drinking black tea is not increased more than before drinking black tea.

In order to prove the hypothesis, the data will be analysed by pair-t-test significant at $p<0.05$.

3.4.2 The changing frequency and spectrum of brainwaves in each frequency band after drinking black tea.

The data for analysis is frequency and spectrum of each brainwave in each frequency band. Frequency and spectrum data will be analysed by pair-t-test, significant at p-value <0.05 to prove hypothesis as follow.

H0 = Frequency of Brainwaves after drinking black tea changed compared to before drinking black tea.

H1 = Frequency of Brainwaves after drinking black tea did not change compare to before drinking black tea.

H0 = Spectrum of brainwaves after drinking black tea changed compared to before drinking black tea.

H1 = Spectrum of highest frequency after drinking black tea did not change compared to before drinking black tea.

CHAPTER 4

RESULTS

The analysis of the study, Brainwave and attentive process in cumulative drinking of black tea, The researcher enrolled 20 working people to participate the study. All of the participants were 21 – 55 years old Thais and working in urban areas. Mean of these participants was 32.55 and SD was 7.90. According to a problem with technical data, one of participants was excluded. The analysis was done by computer programme. The analysis aligned on hypotheses. The results and interpretations are as follow.

Part 1: Spatial ability in cumulative drinking of black tea. This part consists of

1. Reaction time of doing spatial test.
2. Numbers of correct answers

Part 2: The changing of brainwave in cumulative drinking of black tea. This part consist of

1. The changing of brain wave in non screening frequency data (64 Hz)
2. The changing of brainwave in screening frequency data

1) The changing of brainwave in frequency band 13 – 30 Hz (Beta wave range)

2) The changing of brainwave in frequency band 8 – 12 Hz (Alpha wave range)

3) The changing of brainwave in frequency band 4 – 7 Hz (Theta wave range)

4) The changing of brainwave in frequency band 0.5 – 3 Hz (Delta wave range)

In this study, Brainwaves of participants were recorded by Brain Actor2 Channel EEG and an analysis of the different mean of 2 groups of sample population by pair-t-test. The analysed data was brainwave at the period of eye close and eye open before and after

drinking black tea and doing spatial test at 0^{th}, 10^{th}, 20^{th}, 30^{th}minute, the significant at p-value <0.05 or confidence at 95%

In order to prove the hypothesis, the confidence to prove is 95% or significant (α) at p-value <0.05. The conditions to accept or inaccept the hypothesis are as follow.

1. If p-value from the calculation is less than significant value (α), null hypothesis (H_0) can be accepted.

2. If p-value from the calculation is more than significant value (α), null hypothesis (H_0) cannot be accepted.

Hypothesis of the study

1. H0 = Brainwaves after drinking black tea are not different from before drinking black tea by cumulation.

2. H1 = Brainwaves after drinking black tea are different from before drinking black tea by cumulation.

4.1 The Spatial Ability in Cumulative Drinking Black tea Data

4.1.1 Reaction time

Reaction time of spatial test was detected by prolab programme. The results were recorded at the time 0, 10, 20 and 30 minute. Reaction time at 0 minute was time before drinking black tea, therefore, time at 10, 20 and 30 minute were reaction time after drinking black tea. All of data was analysed by pair-t-test, the significant level was p<0.05.

Table 4.1 Comparison of reaction time in each spatial test

Reaction time of spatial	N	$\overline{X}$	SD	t	*p*
Reaction time at 0 minute	19	46.97	19.05	3.43	0.003**
Reaction time at 10 minutes	19	40.55	21.20		
Reaction time at 0 minute	19	46.97	19.05	3.08	0.006**
Reaction time at 20 minutes	19	37.89	25.04		
Reaction time at 0 minute	19	46.97	19.05	3.50	0.003**
Reaction time at 30 minutes	19	34.40	11.10		
Reaction time at 10 minutes	19	40.55	21.20	1.26	0.222
Reaction time at 20 minutes	19	37.89	25.04		
Reaction time at 10 minutes	19	40.55	21.20	1.48	0.155
Reaction time at 30 minutes	19	34.40	11.10		
Reaction time at 20 minutes	19	37.89	25.04	0.70	0.495
Reaction time at 30 minutes	19	34.40	11.10		

Note. ** $p < .01$

According to data in Table 4.4, the comparison of reaction time shown that p-value after doing spatial test in minute 10^{th}, 20^{th} and 30^{th}after drinking black tea was less than 0.05. This means null hypothesis (H_0) can be accepted. The meaning is reaction time of test was decreased after drinking black at 10^{th}, 20^{th} and 30^{th}minutes, significantly ($p<0.05$). Mean of reaction time of doing the spatial test at 10^{th}, $20^{th}$and 30^{th} (40.55, 37.89 and 34.40 second, respectively) decreased significantly during doing the spatial test after drinking black tea at 0^{th}minute (46.97 second).The reaction times of each spatial test are also shown as Figure 4.1.

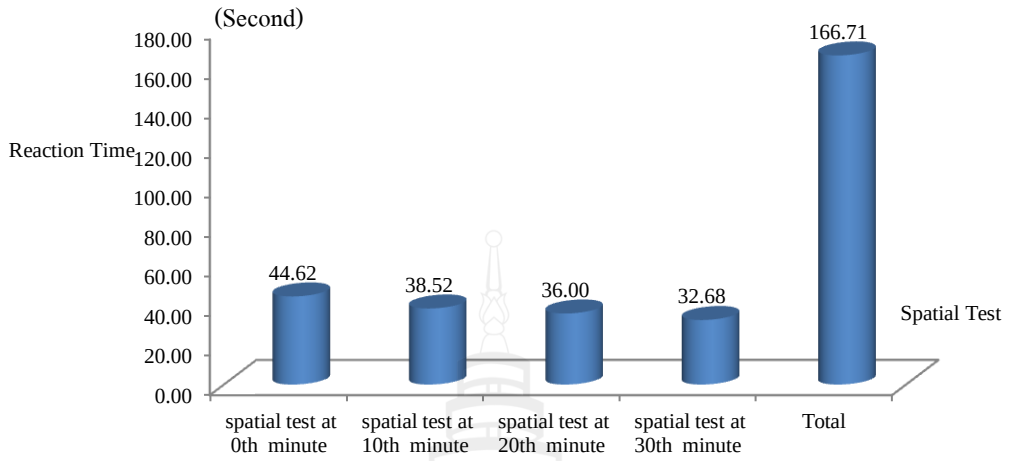


Figure 4.1 Graph shows reaction time of spatial test at 0^{th}, 10^{th}, $20^{th}$and 30^{th}minutes

4.1.2 Number of correct answer

In order to understand attentive process of spatial test in drinking black tea, the number of correct answers was another factor to analyse. The result is to compare number of correct answers in doing spatial test at 0^{th}minute to 10^{th}, $20^{th}$and 30^{th}minutes. The number of correct answers were analysed by pair-t-test. Total numbers of correct answers in each spatial test are shown in figure 4.2. The results are shown in the table 4.2.

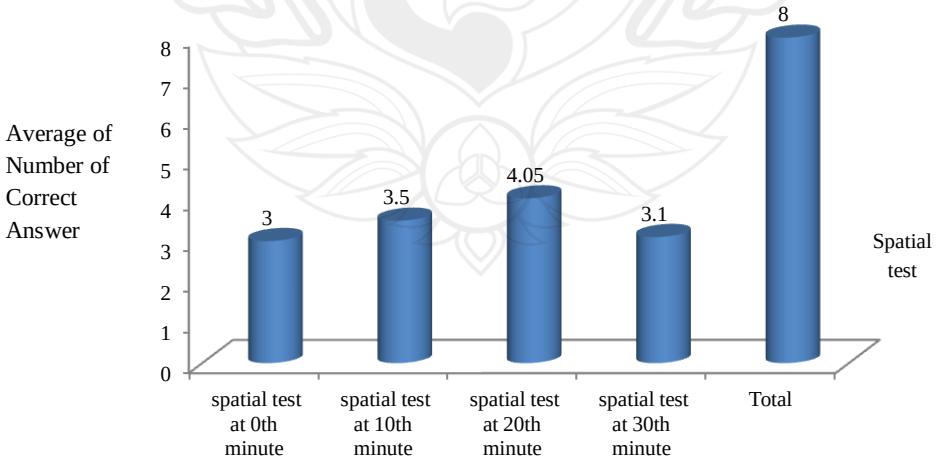


Figure 4.2 Average numbers of correct answers in each spatial test

Table 4.2 Comparison of mean number of correct answer in each spatial test

Number of correct Answer in spatial	n	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	3.16	1.26	-2.54	0.021*
Spatial test at 10th minute	19	3.68	1.42		
Spatial test at 0thminute	19	3.16	1.26	-3.42	0.003**
Spatial test at 20th minute	19	4.26	1.24		
Spatial test at 0thminute	19	3.16	1.26	-0.31	0.761
Spatial test at 30thminute	19	3.26	1.82		
Spatial test at 10th minute	19	3.68	1.42	-1.68	0.110
Spatial test at 20th minute	19	4.26	1.24		
Spatial test at 10th minute	19	3.68	1.42	1.19	0.249
Spatial test at 30thminute	19	3.26	1.82		
Spatial test at 20th minute	19	4.26	1.24	2.56	0.019*
Spatial test at 30thminute	19	3.26	1.82		

Note. * $p < .05$; ** $p < .01$

According to data in Table 4.5, the analysed data from pair-t-test, p-value along doing spatial test at 0thminute to 10thand 20thminute were significant less than 0.05 only 0thminute to 10th and 20thminute. This means null hypothesis can be accepted only first 20 minutes. After 20thminute, the results showed no difference. Mean of number of correct answer at 10th and 20thminute ($\overline{X}$ = 3.68, 4.26) were different significantly compare to 0th minute ($\overline{X}$ = 3.16); however, mean of number of correct answer at 30thminute ($\overline{X}$= 3.26) was not different significantly compare to 0th minute ($\overline{X}$= 3.16).

4.2 The Changing of Brainwave in Cumulative Drinking Black Tea

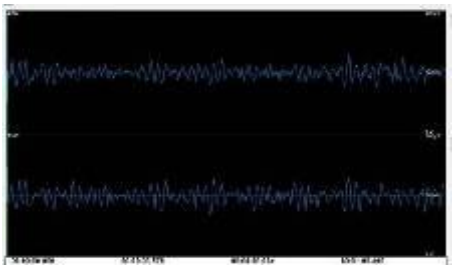
The analysed data changing of brainwaves are highest frequency and spectrum of each frequency band. The data was recorded by Brain actor 2 channels EEG. The analysed data came from 2 channels, first was frequency and spectrum from Fz position, the second was frequency and spectrum from Cz. The frequency and spectrum from both positions were aquisited along the period of eyes closed, eyes open before drinking black tea and during spatial test at 0 minutes, during spatial test after drinking black tea at 10^{th}, $20^{th}$and 30^{th}minute. Finally, acquisition of data at the period of eyes closed and eyes open after doing spatial test at 30^{th}minute. The analysed data was acquisited from non screening frequency band (from frequency 2 – 64 Hz), Beta band frequency (13 – 30 Hz), Alpha band frequency (8 – 12 Hz), Theta band frequency (4 – 7 Hz) and Delta band frequency (0.5 – 3 Hz). The data was analysed by pair-t-test, significant at $p<0.05$.

4.2.1 The changing of brainwave in non screening frequency (64 Hz)

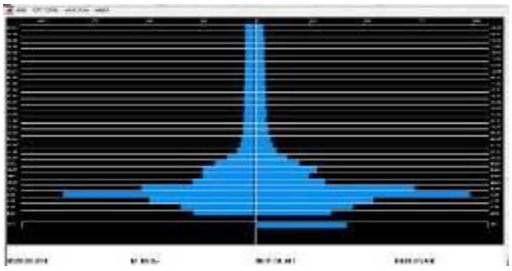
This kind of frequency is not specific to any frequency band. The result was collected from frequency 2 – 64 Hz. The analysis of data is to compare frequency and spectrum change between eyes closed, eyes open before to after drinking black tea, frequency and spectrum change during spatial test at 0^{th}, 10^{th}, $20^{th}$and 30^{th}minute. The data was collected from Fz and Cz position and analysed by pair-t-test, significant at p-value < 0.05.

4.2.1.1 The changing brainwave in frequency 2 – 64 Hz during eye closed period.

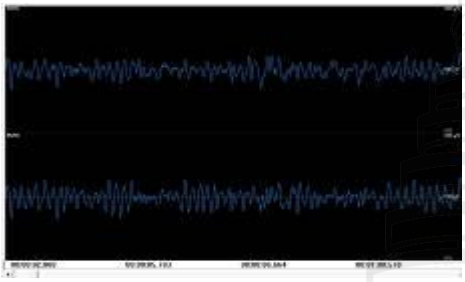
The result of this part is to find frequency and spectrum of Beta wave in eyes closed period before drinking black tea compared to after drinking black tea by Brain Actor. All of data was computed by mind mirror programme as shown in figure 4.3.



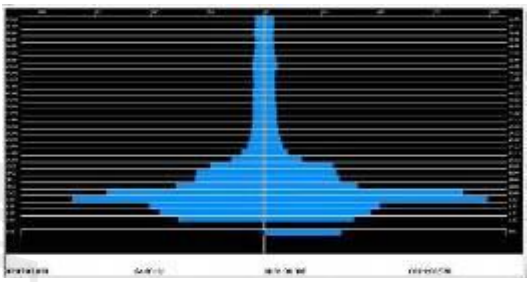
Brainwaves before drinking black tea



Frequencies and spectrums before drinking black tea



Brainwaves after drinking black tea



Frequencies and spectrums after drinking black tea

Figure 4.3 Brainwaves during eye close period at frequency 2 – 64 Hz

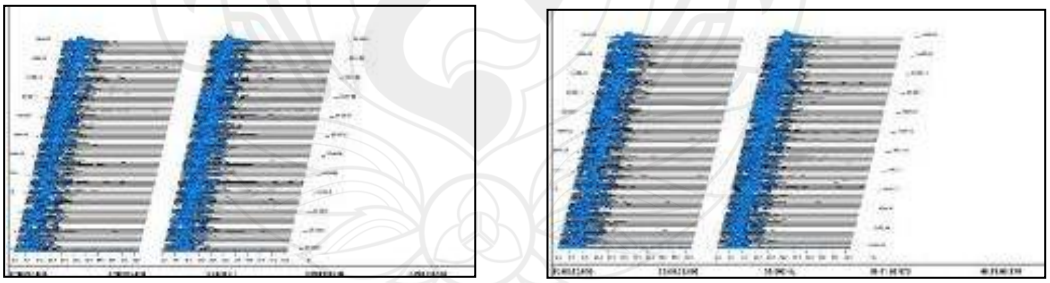
According to the data in figure 4.3, brainwave data (the left side pictures) were computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.6

Table 4.3 Frequency and spectrum during eye close in frequency 2 – 64 Hz

Frequency and Spectrum during Eye Close in frequency 2 – 64 Hz.	**N**	**$\bar{X}$**	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	9.84	3.20	-2.10	0.050
Frequency After drinking at Fz	19	11.05	2.34		
Spectrum Before drinking at Fz	19	42.50	22.43	0.70	0.492
Spectrum After drinking at Fz	19	39.06	20.73		
Frequency Before drinking at Cz	19	11.09	2.60	0.04	0.966
Frequency After drinking at Cz	19	11.05	2.34		
Spectrum Before drinking at Cz	19	44.59	25.97	0.15	0.884
Spectrum After drinking at Cz	19	43.97	27.09		

According to data in table 4.3, p-value of both frequency and spectrum of brainwave at Fz and Cz position, during eyes closed period, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of brainwave, frequency 2 – 64 Hz at Fz position, during eyes closed was not significantly increased between, before, and after drinking black tea. Mean of frequency of brainwave during eyes closed at Fz after drinking black tea ($\overline{X}$ = 11.05) was not increased significantly from frequency of brainwave before drinking black tea ($\overline{X}$ = 9.84); however, spectrum of brainwave at Fz position and frequency and brainwave of brainwave at Cz, frequency 2 – 64 Hz at Fz position, during eye closed were not significantly decreased between before and after drinking black tea Mean of spectrum of brainwave at Fz and frequency and spectrum at Cz position, during eyes closed, after drinking black tea ($\overline{X}$ = 39.06, 11.05 and 43.97, respectively) were not decreased significantly from spectrum of brainwave at Fz and frequency and spectrum of brainwave at Cz before drinking black tea ($\overline{X}$ = 11.09, 42.50 and 44.59, respectively).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.4. The 3D has shown dominant alpha waves in both left and right sides of the brain. Alpha wave also showed both eyes closed period before and after drinking black tea.



3D picture of eyes closed before drinking black tea 3D picture of eyes closed after drinking black tea

Figure 4.4 3D-Landscape- Darstellung of brainwave during eye close period in frequency 2 – 64 Hz

4.2.1.2 The changing brainwave in frequency 2 – 64 Hz during eye open period.

The result of this part is to find frequency and spectrum in screen of Brain Actor of eye open in the time before drinking black compared to after drinking black tea. After detection of brainwaves, all of brainwaves had to be computed from mind mirror programme as shown in figure 4.5

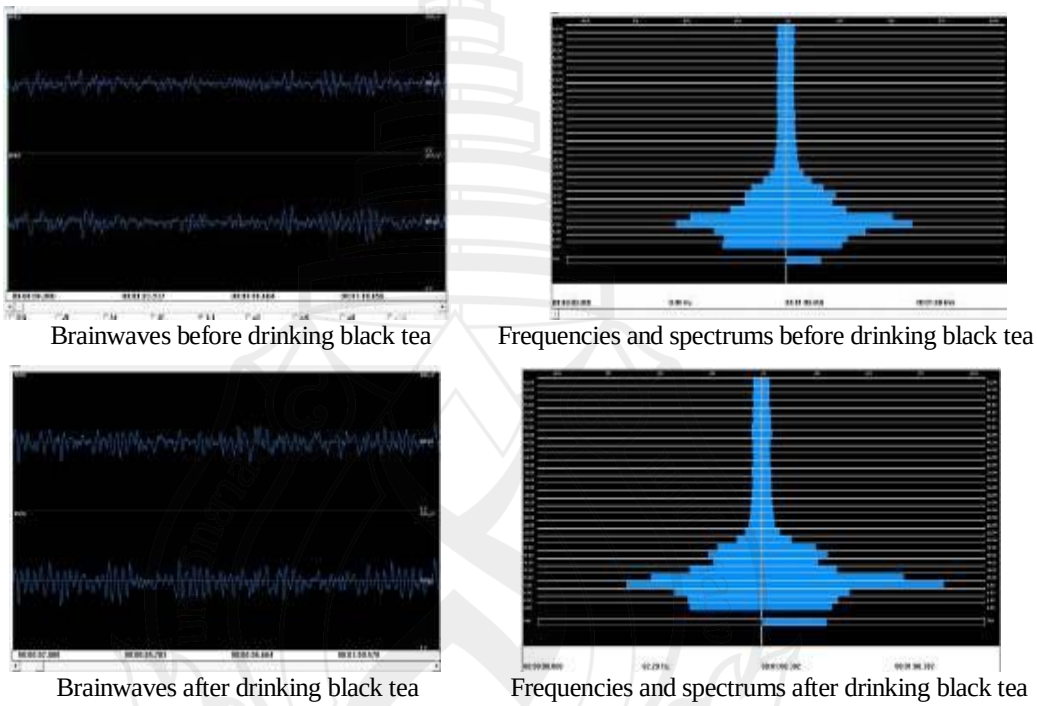


Figure 4.5 Frequency and Spectrum of brainwaves during eye open period at frequency 2 – 64 Hz

According to the data in figure 4.5, brainwave data (the left side pictures) were computed by mind mirror programme (the right side pictures). The results were data from both Fz (the left side of screen in mind mirror) and Cz positions the right side of screen in mind mirror). The comparison data was analysed by pair-t-test and shown as in the table 4.4.

Table 4.4 Frequency and spectrum of eye open at frequency 2 – 64 Hz

Frequency and Spectrum of brainwave during eye open	N	$\overline{X}$	SD	t	*p*
Frequency Before drinking at Fz	19	8.21	4.42	0.20	0.843
Frequency After drinking at Fz	19	8.05	4.43		
Spectrum Before drinking at Fz	19	25.96	12.79	0.79	0.441
Spectrum After drinking at Fz	19	23.93	13.45		
Frequency Before drinking at Cz	19	8.63	3.95	-0.22	0.826
Frequency After drinking at Cz	19	8.74	4.12		
Spectrum Before drinking at Cz	19	21.93	13.59	0.11	0.911
Spectrum After drinking at Cz	19	21.60	19.13		

According to data in table 4.7, the p-value of frequency and spectrum, during eye open period, before and after drinking black tea both Fz and Cz position were more than 0.05. Null hypothesis (H_0) cannot be accepted. Frequency and spectrum of brainwave, frequency 2 – 64 Hz, at Fz position, and spectrum of brainwave at Cz position during eyes open was not decreased significantly between before and after drinking black tea. Mean of frequency and spectrum of brainwave at Fz position, and spectrum of brainwave at Cz position during eyes open after drinking black tea ($\overline{X}$ = 8.05, 23.93 and 21.60, respectively) were not decreased from frequency of brainwave at Fz and spectrum at Cz before drinking black tea ($\overline{X}$ = 8.21, 25.96 and 21.93, respectively); however, frequency of brainwave at Cz position, in frequency 2 – 64 Hz, during eyes open was not increased significantly between before and after drinking black tea. Mean of frequency of brainwave, during eye open, at Cz, after drinking black tea ($\overline{X}$ = 8.74) was not increased from spectrum in Fz position and frequency and spectrum at Cz position before drinking black tea ($\overline{X}$ = 8.63).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.6. The 3D has shown alpha waves in both left and right sides of the brain in frequency 2 – 64 Hz. Alpha waves also shown in both before and after drinking black tea.

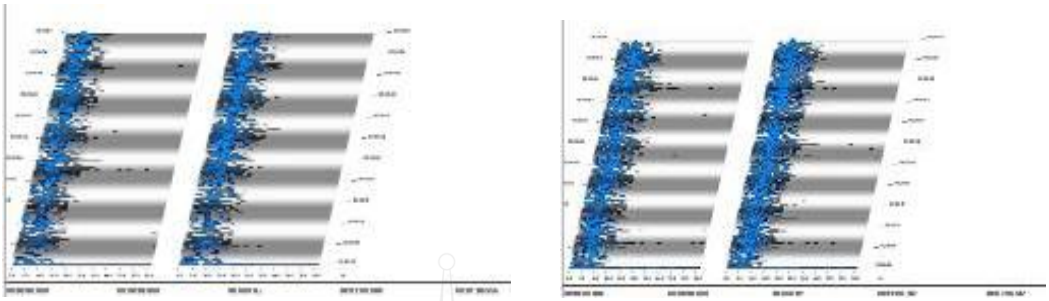
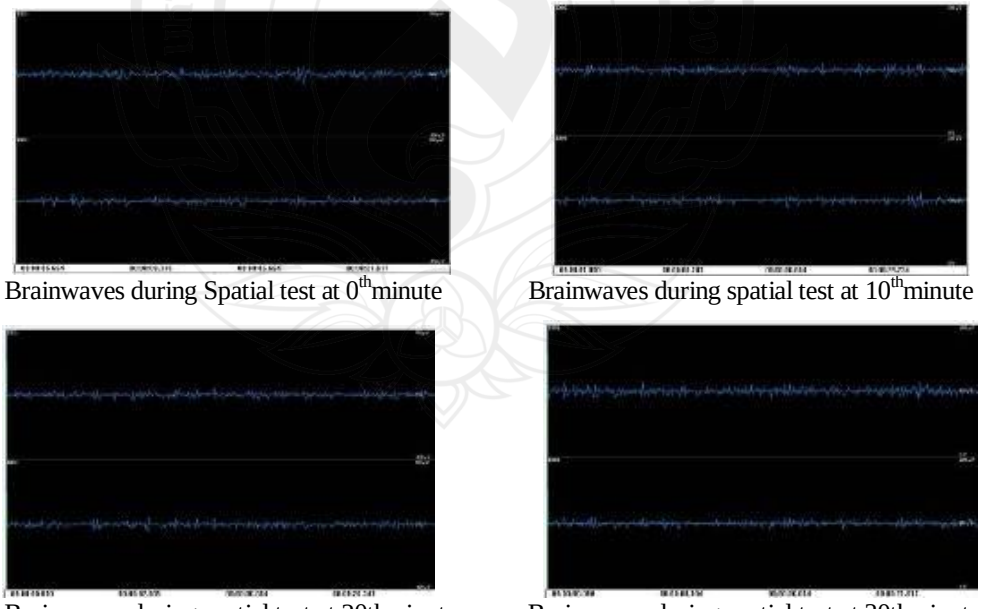


Figure 4.6 3D-Landscape- Darstellung of brainwaves during eyes open period in frequency 2 – 64 Hz

4.2.1.3 The changing frequency and spectrum of brainwave in 2 – 64 Hz during doing spatial test at Fz and Cz position.

The result of this part is to find frequency and spectrum of brainwave in frequency 2 – 64 Hz on screen of Brain Actor during doing spatial test at the time 0^{th}minute and doing spatial test with drinking black tea at the time 10^{th}, $20^{th}$and 30^{th}minute. Brainwaves on screen of Brain Actor (figure 4.7) were computed by mind mirror programme (Figure 4.8). All of the data was analysed by pair-t-test, significant level at p-value <0.05.



Brainwaves during Spatial test at 0^{th}minute

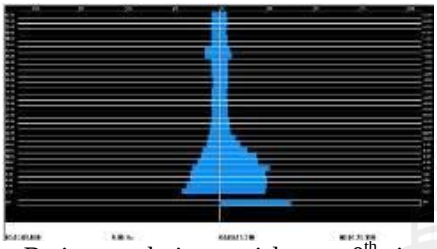
Brainwaves during spatial test at 10^{th}minute

Brainwaves during spatial test at 20thminute

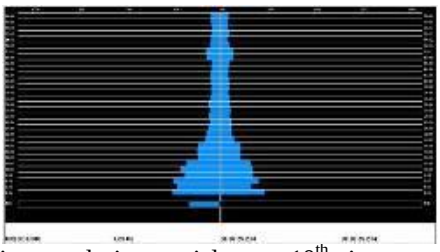
Brainwaves during spatial test at 30thminute

Figure 4.7 Picture shows brainwaves in frequency 2 – 64 Hz during spatial test period

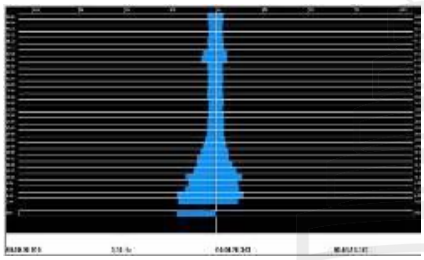
Concerning to all of brainwaves from Figure 4.7, the data can be computed to find frequencies and spectrums change by mind mirror programme as the Figure 4.8.



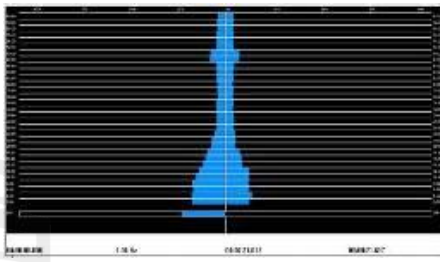
Brainwave during spatial test at 0th minute



Brainwave during spatial test at 10th minute



Brainwave during spatial test at 20th minute



Brainwave during spatial test at 30thminute

Figure 4.8 Frequency and spectrum of brainwave during spatial test on mind mirror screen

According to data from figure 4.7 and 4.8, the data shows brainwaves in both position Fz (the left side of the screen) and Cz (the right side of the screen). The data computed from mind mirror programme as figure 4.8. All of the data was analysed by pair-t-test, significant level at p-value <0.05.

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.9. The 3D has shown brain wave in area of theta and alpha waves in both left and right sides of the brain in frequency 2 – 64 Hz. The amount of both theta and alpha wave were in decline during the spatial test of drinking black tea.

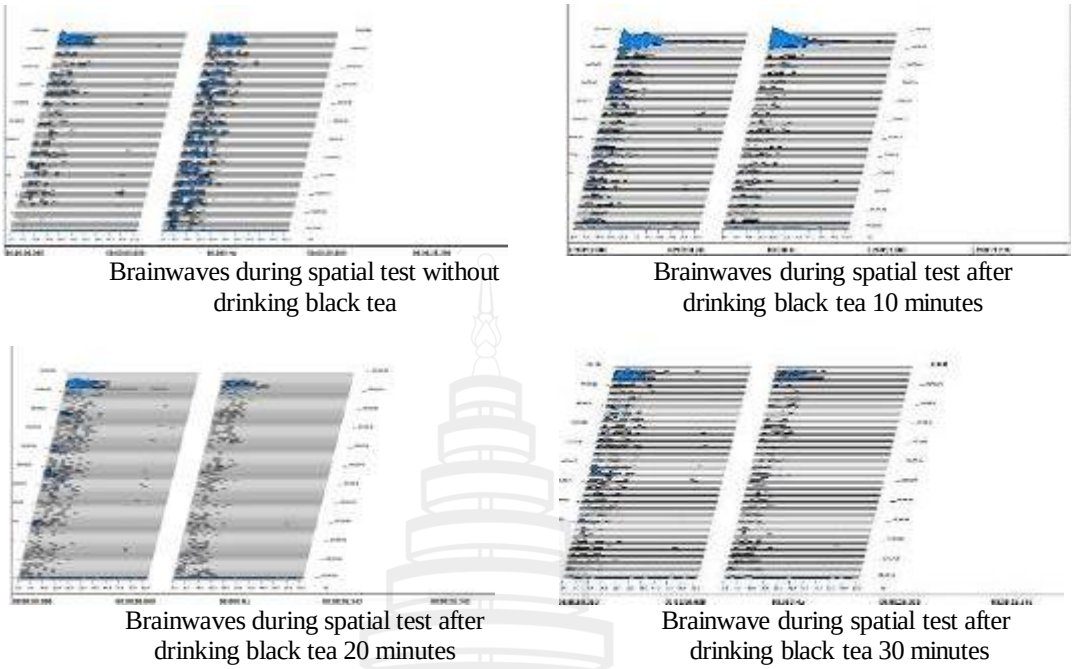


Figure 4.9 3D-Landscape-Darstellung of brainwaves during spatial test in frequency 2 – 64 Hz

4.2.1.4 The changing frequency of brainwaves in frequency 2 – 64 Hz during spatial test at Fz position.

Table 4.5 Frequency of brainwave in frequency 2 – 64 Hz during spatial test at Fz position

Frequency in 2 - 64 Hz During spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	6.37	2.65	0.65	0.525
Spatial test at 10th minute	19	6.00	2.40		
Spatial test at 0thminute	19	6.37	2.65	-0.28	0.786
Spatial test at 20th minute	19	6.53	3.32		
Spatial test at 0thminute	19	6.37	2.65	1.33	0.199
Spatial test at 30thminute	19	5.47	1.98		
Spatial test at 10th minute	19	6.00	2.40	-0.65	0.523

Table 4.5 (continued)

Frequency in 2 - 64 Hz During spatial test at Fz	n	$\overline{X}$	SD	t	*p*
Spatial test at 20th minute	19	6.53	3.32		
Spatial test at 10th minute	19	6.00	2.40	0.84	0.413
Spatial test at 30thminute	19	5.47	1.98		
Spatial test at 20th minute	19	6.53	3.32	1.65	0.116
Spatial test at 30thminute	19	5.47	1.98		

According to data in table 4.5, p-value of frequency of brainwave in frequency 2 – 64 Hz during doing spatial test period at Fz position found more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of brainwave in frequency 2 – 64 Hz during doing spatial test at 10thand 30thminute after drinking black tea showed no difference significantly compared to doing spatial test after drinking black tea at 0th minute. Mean of frequency of brainwave during spatial test at 10thand 30thminute after drinking black tea ($\overline{X}$= 6.00, 5.47, respectively) were not decreased significantly from frequency of brainwave during spatial test before drinking black tea at 0thminute ($\overline{X}$= 6.37); however, frequency of brainwave in frequency 2 – 64 Hz during spatial test at 20th minute after drinking black tea was not increased significantly from frequency during spatial test after drinking black tea at 0th minute. Mean of frequency of brainwave during spatial test at 20th minute after drinking black tea ($\overline{X}$= 6.53) was not different from frequency of brainwave during spatial test after drinking black tea at 0thminute ($\overline{X}$= 6.37). Moreover, frequency of brainwave in frequency 2 – 64 Hz during spatial test at 20th minute after drinking black tea was not increased significantly from frequency during spatial test after drinking black tea at 10th minute. Mean of frequency of brainwave during spatial test at 20thminute after drinking black tea ($\overline{X}$= 6.53) was not increased from frequency of brainwave during spatial test after drinking black tea at 10thminute ($\overline{X}$= 6.00). Finally, frequency of brainwave in frequency 2 – 64 Hz during spatial test at 30th minute after drinking black tea was not decreased significantly from frequency during spatial test after drinking black tea at 10th and 20th minute. Mean of

frequency of brainwave during spatial test at 30thminute after drinking black tea ($\overline{X}$= 5.47) was not decreased from frequency of brainwave during doing spatial test after drinking black tea at 10th and 20th minute ($\overline{X}$= 6.00 and 6.53, respectively).

1. The changing spectrum of brainwave during doing spatial test at Fz position

Regarding to spectrum of brainwave, p-value of brainwave in frequency 2 – 64 Hz, during doing spatial test period at Fz, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrums of brainwaves in frequency 2 – 64 Hz during doing spatial test at 20th and 30thminutes after drinking black tea were not significantly increased compared to doing spatial test at 0th minute before drinking black tea. Mean of spectrum of brainwaves during spatial test at 20thand 30th minute after drinking black tea ($\overline{X}$= 21.41 and 25.63, respectively) were not increased significantly from spectrum of brainwaves during spatial test after drinking black tea at 0thminute ($\overline{X}$= 23.52); however, spectrum of brianwaves in frequency 2 – 64 Hz during spatial test at 10th minute after drinking black tea were not significantly decreased compared to doing spatial test at 0th minute before drinking black tea. Mean of spectrums of brainwaves during spatial test at 10th minute after drinking black tea ($\overline{X}$= 21.41) was not decreased from spectrums of brainwaves during doing spatial test after drinking black tea at 0thminute ($\overline{X}$= 23.52). Moreover, spectrum of brainwave in frequency 2 – 64 Hz during spatial test at 20th minute after drinking black tea was not significantly increased from spectrums during spatial test at 10th minute after drinking black tea. Mean of spectrums of brainwaves during spatial test at 20thminute after drinking black tea ($\overline{X}$= 25.63) was not increased significantly from spectrums of brainwaves during spatial test after drinking black tea at 10thminute ($\overline{X}$= 21.41). Finally, spectrums of brainwaves in frequency 2 – 64 Hz during spatial test at 30th minute after drinking black tea was not significantly increased from spectrums during spatial test at 10th and 20th minute after drinking black tea. Mean of spectrums of brainwaves during spatial test at 30thminute after drinking black tea ($\overline{X}$= 26.21) was not increased significantly from spectrums of brainwaves during spatial test after drinking black tea at 10th and 20th minute ($\overline{X}$= 21.41 and 25.63, respectively). The results are as in table 4.6.

Table 4.6 Spectrums of brainwaves in frequency 2 – 64 Hz during spatial test at Fz position

Spectrum of brainwave in 2 - 64 Hz during spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	23.52	13.15	0.65	0.525
Spatial test at 10th minute	19	21.41	10.57		
Spatial test at 0thminute	19	23.52	13.15	-0.28	0.786
Spatial test at 20th minute	19	25.63	18.72		
Spatial test at 0thminute	19	23.52	13.15	1.33	0.199
Spatial test at 30thminute	19	26.21	17.52		
Spatial test at 10th minute	19	21.41	10.57	-0.65	0.523
Spatial test at 20th minute	19	25.63	18.72		
Spatial test at 10th minute	19	21.41	10.57	0.84	0.413
Spatial test at 30thminute	19	26.21	17.52		
Spatial test at 20th minute	19	25.63	18.72	1.65	0.116
Spatial test at 30thminute	19	26.21	17.52		

2. The changing frequency of brainwaves during spatial test at Cz position

Table 4.7 Frequency of brainwaves in frequency 2 – 64 Hz during spatial test at Cz position

Freq of brainwave in 2 - 64 Hz during spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	7.79	3.52	0.66	0.518
Spatial test at 10th minute	19	8.21	4.05		
Spatial test at 0thminute	19	7.79	3.52	-0.47	0.642
Spatial test at 20th minute	19	8.26	4.29		
Spatial test at 0thminute	19	7.79	3.52	-0.64	0.529
Spatial test at 30thminute	19	7.68	3.90		

Table 4.7 (continued)

Freq of brainwave in 2 - 64 Hz during spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 10th minute	19	8.21	4.05	-1.43	0.170
Spatial test at 20th minute	19	8.26	4.29		
Spatial test at 10th minute	19	8.21	4.05	-1.93	0.069
Spatial test at 30thminute	19	7.68	3.90		
Spatial test at 20th minute	19	8.26	4.29	-0.49	0.629
Spatial test at 30thminute	19	7.68	3.90		

According to data in table 4.7, p-value of frequency of brainwaves in 2 – 64 Hz, during spatial test period at Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of brainwaves during spatial test at 10th and 20th minute after drinking black tea were not increased significantly compared to doing spatial test after drinking black tea at 0thminute in frequency band 2 – 64 Hz. Mean of frequency of brainwaves in spatial test at 10th and 20thminute after drinking black tea ($\overline{X}$= 8.21 and 8.26, respectively) were not different significantly from frequency of brainwaves before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 7.79); however, frequency of brainwaves during spatial test after drinking black tea at 30th minute was not significantly decreased from frequency of brainwave during spatial test at 0th minute before drinking black tea. Mean of frequency of brainwaves during spatial test at 30thminute after drinking black tea ($\overline{X}$= 7.68) was not decreased significantly from frequency of brainwave during spatial test before drinking black tea at 0thminute ($\overline{X}$= 7.79). Moreover, frequency of brainwaves during doing spatial test after drinking black tea at 20th minute was not significantly increased from frequency of brainwaves during spatial test at 10th minute after drinking black tea. Mean of frequency of brainwaves during spatial test at 20thminute after drinking black tea ($\overline{X}$= 8.26) was not increased significantly from frequency of brainwaves during spatial test after drinking black tea at 10thminute ($\overline{X}$= 8.21). According to mean of brainwaves at Cz position, frequency in this range showed dominantly alpha wave frequency (8 – 12 Hz).

3. The changing spectrum of brainwave during spatial test at Cz position

Regarding to spectrums of brainwaves, p-value of spectrum of brainwaves in 2 – 64 Hz, during doing spatial test period at Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrums of brainwaves during spatial test in frequency 2 – 64 Hz at 10^{th}, $20^{th}$and 30^{th}minute after drinking black tea were not decreased significantly from spectrums during spatial test at 0^{th}minute or before drinking black tea. Mean of spectrum of brainwaves during spatial test at 10^{th}, 20^{th} and 30^{th}minute after drinking black tea ($\overline{X}$= 16.57, 16.50, 17.05, respectively) were not decreased significantly from spectrums during spatial test after drinking black tea at 0^{th}minute ($\overline{X}$= 17.43). Nevertheless, spectrums of brainwaves during spatial test in frequency 2 – 64 Hz at 20^{th}minute was not decreases significantly from spectrums during spatial test at 10^{th}minute after drinking black tea. Mean of spectrums of brainwaves during spatial test after drinking black tea at 20^{th}minute ($\overline{X}$= 16.50) was not different significantly from spectrums of brainwaves during spatial test after drinking black tea at 10^{th} minute ($\overline{X}$= 16.57). Moreover, spectrum of brainwave during spatial test at 30^{th}minute was not increased significantly from spectrums during spatial test at 10^{th} and 20^{th} minute after drinking black tea. Mean of spectrums of brainwaves during spatial test after drinking black tea at 30^{th}minutes ($\overline{X}$= 17.05) was not increased significantly from spectrums after drinking black tea at 10^{th} and 20^{th}minutes ($\overline{X}$= 16.57 and 16.50, respectively). The results are as in table 4.8.

Table 4.8 Spectrum of brainwave during doing spatial test in frequency 2 – 64 Hz at Cz position

Spectrum of brainwave in 2 – 64 Hz during spatial test at Cz	**N**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0^{th} minute	19	17.43	7.72	-0.44	0.663
Spatial test at 10^{th} minute	19	16.57	6.68		
Spatial test at 0^{th}minute	19	17.43	7.72	-0.52	0.612
Spatial test at 20^{th} minute	19	16.50	6.42		
Spatial test at 0^{th}minute	19	17.43	7.72	0.11	0.913

Table 4.8 (continued)

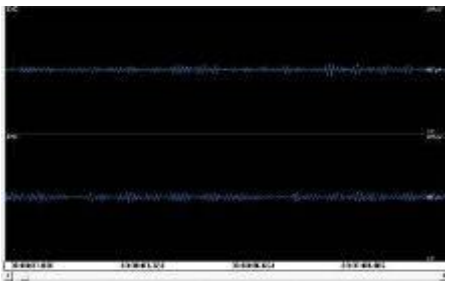
Spectrum of brainwave in 2 – 64 Hz during spatial test at Cz	N	$\overline{X}$	SD	t	*p*
Spatial test at 30thminute	19	17.05	6.23		
Spatial test at 10th minute	19	16.57	6.68	-0.09	0.928
Spatial test at 20th minute	19	16.50	6.42		
Spatial test at 10th minute	19	16.57	6.68	0.86	0.399
Spatial test at 30thminute	19	17.05	6.23		
Spatial test at 20th minute	19	16.50	6.42	1.06	0.305
Spatial test at 30thminute	19	17.05	6.23		

4.2.2 The changing of frequency and Spectrum of Betawave

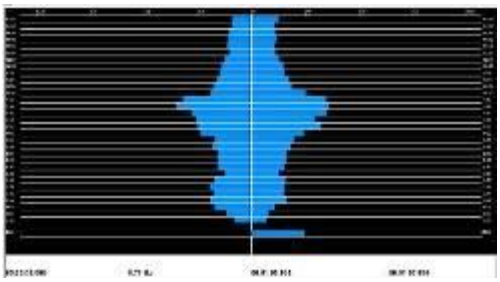
This kind of frequency is specific only frequencies range 13 – 30 Hz or beta wave range. The result was collected from frequency 13 - 30 Hz. The analysis of data is to compare frequency and spectrum of Beta wave that change when eyes close, eyes open, before to after drinking black tea, frequency and spectrum of betawave that change during doing spatial test at 0th, 10th, 20thand 30thminute. The data of eyes closed and eyes open was analysed by pair-t-test. The data of during doing spatial test was also analysed by pair-t-test, significant at p-value <0.05.

4.2.2.1 The changing frequency and spectrum of Betawave during eye close period.

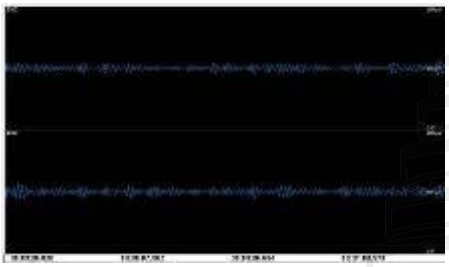
The result of this part is to find frequency and spectrum of betawave in eyes closed period before drinking black compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme as shown in Figure 4.10



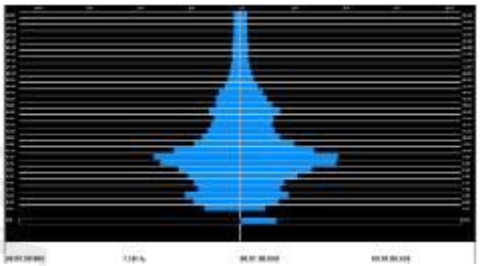
Beta wave before drinking black tea



Frequency and spectrum before drinking black tea



Brainwave after drinking black tea



Frequency and spectrum after drinking black tea

Figure 4.10 Picture shows frequency and spectrum of betawaves in eyes close period

According to the data in figure 4.10, Beta wave data (the left side pictures) were computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.9.

Table 4.9 Frequency and spectrum of Beta wave in eye close period

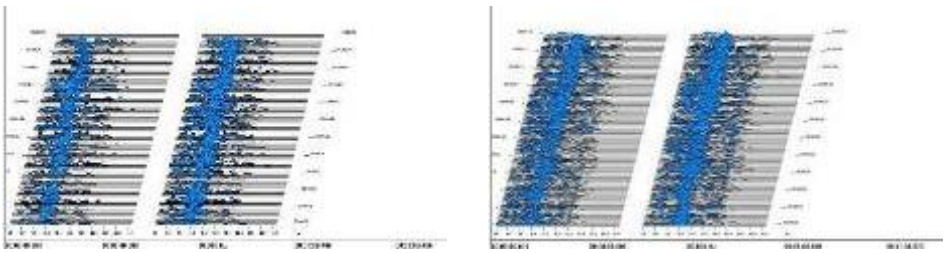
Frequency and Spectrum of Beta wave in eye close peroid	**N**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	14.32	1.16	-2.95	**0.009
Frequency After drinking at Fz	19	15.55	1.99		
Spectrum Before drinking at Fz	19	12.99	7.55	0.09	0.931
Spectrum After drinking at Fz	19	12.86	6.33		
Frequency Before drinking at Cz	19	14.47	1.31	-1.46	0.163

Table 4.9 (continued)

Frequency and Spectrum of Beta wave in eye close peroid	N	$\overline{X}$	SD	t	*p*
Frequency After drinking at Cz	19	15.11	1.79		
Spectrum Before drinking at Cz	19	12.66	5.71	0.59	0.561
Spectrum After drinking at Cz	19	11.90	4.89		

According to data in table 4.9, p-value of frequency of betawave in eyes closed period, at Fz position, was less than significant level 0.05. Null hypothesis (H_0) can be accepted. That means mean frequency of betawave during eyes closed period after drinking black tea ($\overline{X}$= 15.55) was increased significantly from before drinking black tea ($\overline{X}$= 14.32), however, p-value of betawave during eyes closed, at Cz position, and spectrum of betawaves at Fz and Cz position were more than significant level 0.05. Spectrum of betawaves at Fz and Cz position during eyes closed period after drinking black tea were not decreased significantly from spectrums before drinking black tea. Mean of spectrum of betawaves at Fz and Cz position during eyes closed period after drinking black tea ($\overline{X}$= 12.86 and 11.90, respectively) were not decreased significantly from spectrums at Fz and Cz before drinking black tea ($\overline{X}$= 12.99 sand 12.66, respectively). Moreover, frequency of betawave at Cz position during eyes closed period after drinking black tea was not increased significantly from frequency before drinking black tea. Mean of frequency of betawaves during eyes closed period, at Cz, after drinking black tea ($\overline{X}$= 15.11) was not increased significantly from frequency before drinking black tea ($\overline{X}$= 14.47).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.10. The 3D has shown brainwaves in area of theta and alpha waves in both left and right sides of the brain in betawave frequency along eyes closed period when the comparison between before and after drinking black tea.

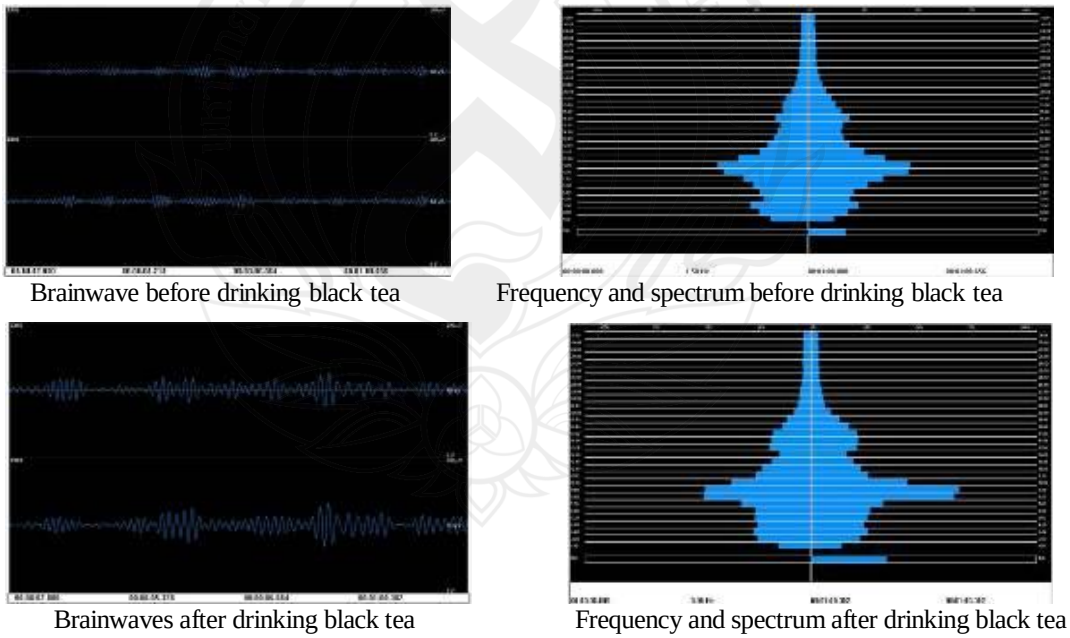


Brainwaves before drinking black tea Brain waves after drinking black tea

Figure 4.11 Picture of 3D-Landscape-Darstellung in betawave frequency during eye close period

4.2.2.2 The changing frequency and spectrum of Beta wave in period of eye open.

The result of this part is to find frequency and spectrum of betawave in eyes open period before drinking black compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme as shown in figure 4.12



Brainwave before drinking black tea Frequency and spectrum before drinking black tea

Brainwaves after drinking black tea Frequency and spectrum after drinking black tea

Figure 4.12 Picture shows frequency and spectrum of betawave in eyes open period

According to the data in figure 4.12, betawave data (the left side pictures) were computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.10.

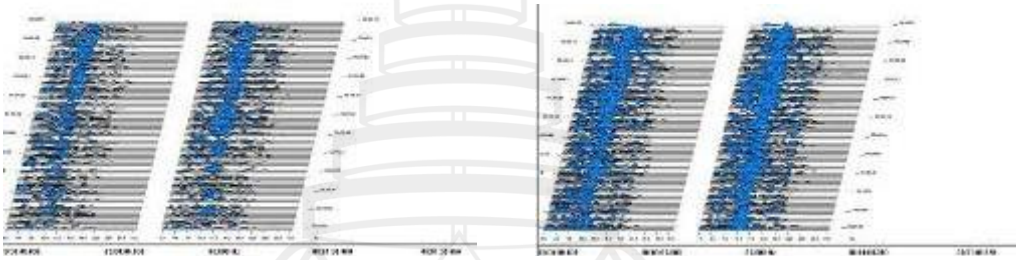
Table 4.10 Frequency and spectrum of betawaves in eyes open period

frequency and Spectrum of betawave in Eye open	**N**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	14.74	1.24	-0.08	0.939
Frequency After drinking at Fz	19	14.76	1.08		
Spectrum Before drinking at Fz	19	12.23	5.10	1.78	0.091
Spectrum After drinking at Fz	19	10.05	4.40		
Frequency Before drinking at Cz	19	14.79	1.27	0.37	0.716
Frequency After drinking at Cz	19	14.74	1.37		
Spectrum Before drinking at Cz	19	10.91	3.95	0.97	0.345
Spectrum After drinking at Cz	19	9.87	4.85		

According to data in table 4.10, p-value of frequency and spectrum of betawave during eyes open period, at Fz and Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of betawave during eyes open period at Fz position was not increased significantly between before and after drinking black tea. Mean of frequency of beta wave during eyes open period at Fz after drinking black tea ($\overline{X}$= 14.76) was not increased significantly from frequency before drinking black tea ($\overline{X}$= 14.74). Spectrum of betawave at Fz and frequency and spectrum of Beta wave at Cz during eyes open period were not decreased significantly between before and after drinking black tea. Mean of spectrum of beta wave at Fz position and frequency and spectrum of betawave in eyes open period at Cz after drinking black tea ($\overline{X}$= 10.05, 14.74 and 9.87, respectively) was not decreased significantly from spectrum at Fz and

frequency and spectrum at Cz before drinking black tea ($\overline{X}$ = 12.23, 14.79 and 10.91, respectively).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the figure 4.12. The 3D has shown brain wave in area of theta and alpha waves in both left and right sides of the brain in betawave frequency. The amount of both theta and alpha waves were increased during eyes open after drinking black tea.

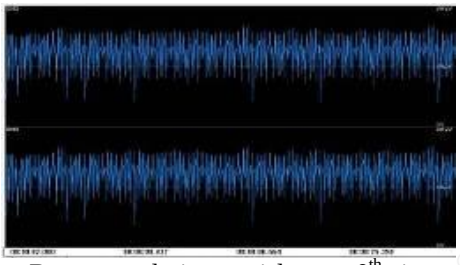


Brainwaves before drinking black tea Brainwaves after drinking black tea

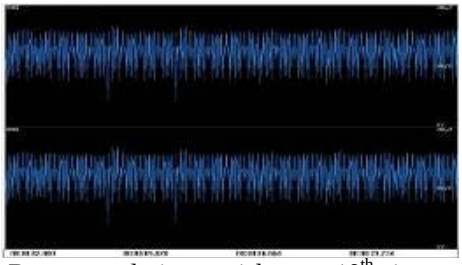
Figure 4.13 3D-Landscape-Darstellung in betawave frequency during eye open period

4.2.2.3 The changing frequency and spectrum of Beta wave during doing spatial test with drinking black tea at Fz at Cz postion.

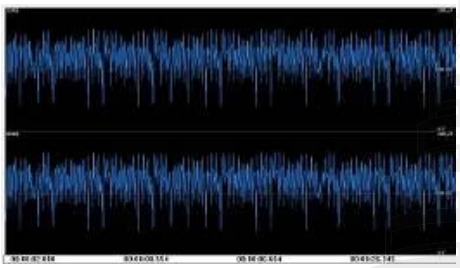
The result of this part is to find frequency and spectrum of betawaves on screen of Brain Actor during doing spatial test at the time 0 minute and doing spatial test with drinking black tea at the time 10^{th}, $20^{th}$and 30^{th}minutes. Betawaves on screen of Brain Actor (Figure 4.14) was computed by mind mirror programme (Figure 4.15). All data was analysed by pair-t-test, significant level is 0.05.



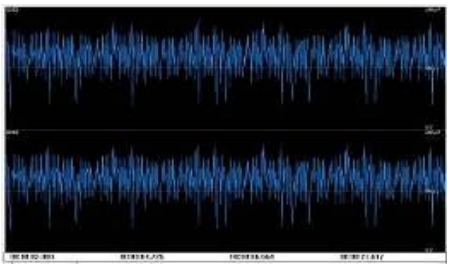
Betawaves during spatial test at 0th minute



Betawaves during spatial test at 10th minute



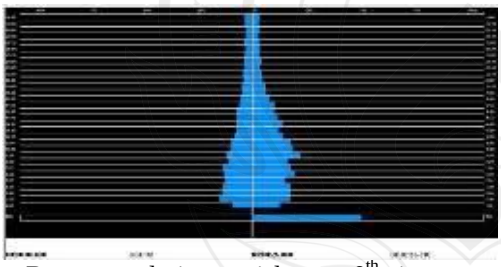
Betawaves during spatial test at 20th minute



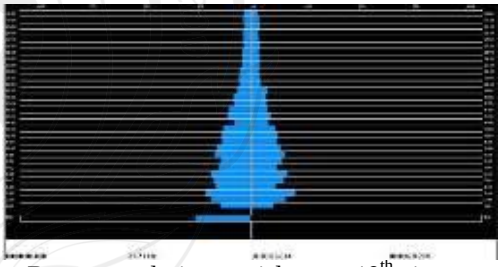
Betawaves during spatial test at 30th minute

Figure 4.14 Betawaves during doing spatial test period on Brain Actor

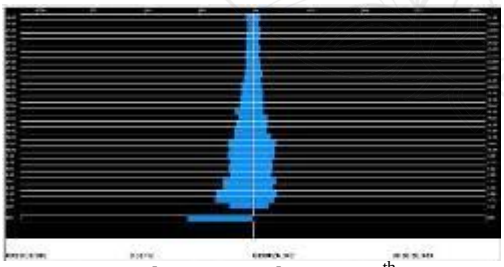
Concerning all brainwaves from figure 4.14, the data can be computed to find frequencies and spectrums change by mind mirror programme as the figure 4.15.



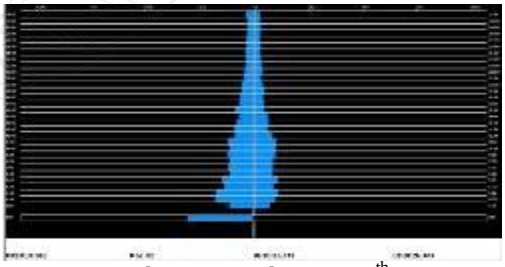
Betawaves during spatial test at 0th minute



Betawaves during spatial test at 10th minute



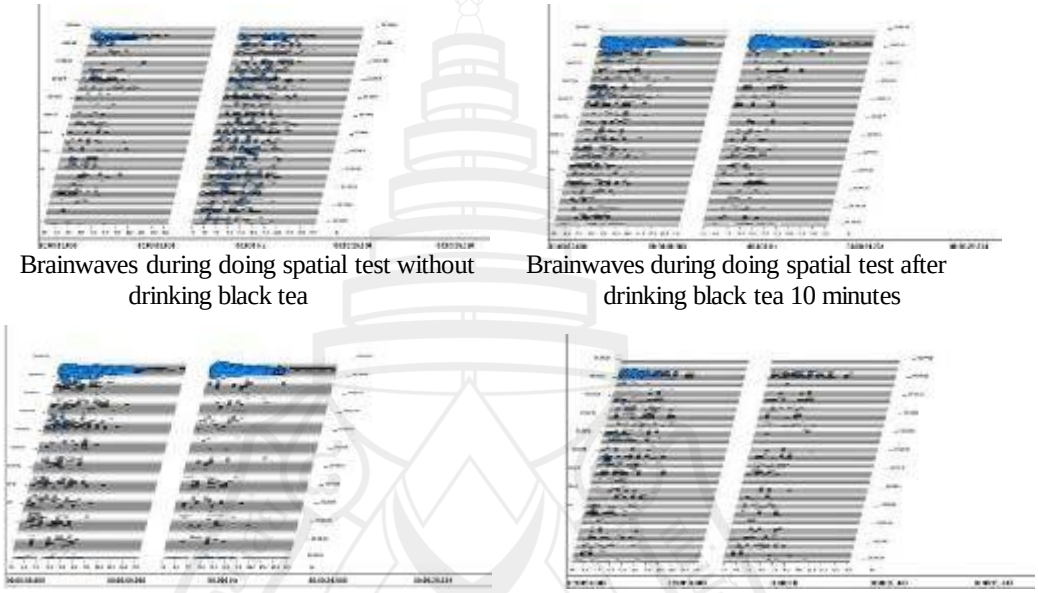
Betawaves during spatial test at 20th minute



Betawaves during spatial test at 30th minute

Figure 4.15 Pictures show frequencies and spectrums of betawaves during spatial on mind mirror screen

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.15. The 3D has shown brain waves in areas of theta and alpha waves in both left (left side of picture) and right side (right side of picture) of brain in beta wave frequency. The amount of both theta and alpha waves were shown at 26 ms during each spatial test after drinking black tea.



Brainwaves during doing spatial test without drinking black tea

Brainwaves during doing spatial test after drinking black tea 10 minutes

Brainwaves during doing spatial test after drinking black tea 20 minutes

Brainwaves during doing spatial test after drinking black tea 30 minutes

Figure 4.16 3D-Landscape-Darstellung of betawaves frequency during spatial test period

1. The changing frequency of betawaves during doing spatial test at Fz position

Table 4.11 Table shows frequency of betawaves during spatial test at Fz position

Frequency of Betawave During spatial test at Fz	**N**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	14.58	0.96	-0.19	0.848
Spatial test at 10th minute	19	14.63	0.68		
Spatial test at 0thminute	19	14.58	0.96	-1.82	0.85
Spatial test at 20th minute	19	15.26	1.52		
Spatial test at 0thminute	19	14.58	0.96	-0.64	0.531
Spatial test at 30thminute	19	14.79	0.92		
Spatial test at 10th minute	19	14.63	0.68	-1.84	0.083
Spatial test at 20th minute	19	15.26	1.52		
Spatial test at 10th minute	19	14.63	0.68	-0.55	0.591
Spatial test at 30thminute	19	14.79	0.92		
Spatial test at 20th minute	19	15.26	1.52	1.23	0.235
Spatial test at 30thminute	19	14.79	0.92		

According to data in table 4.11, p-value of frequency of betawaves during spatial test period at Fz position were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of betawaves during spatial test at 10th, 20thand 30thminute after drinking black tea were not increased significantly from frequency during spatial test before drinking black tea at 0thminute. Mean of frequency of betawave during spatial test at 10th, 20thand 30thminute or after drinking black tea ($\overline{X}$= 14.63, 15.26, 14.79, respectively) was not increased significantly from frequency of betawaves before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 14.58). Moreover, frequency of betawaves during spatial test at 20thand 30thminute after drinking black tea were not increased significantly from frequency during doing spatial test after drinking black tea at 10thminute. Mean of frequency of betawaves during spatial test at 20thand 30thminute

($\overline{X}$= 15.26, 14.79, respectively) was not increased significantly from frequency of betawaves in doing spatial test at 10thminute ($\overline{X}$=14.63). Finally, frequency of betawave during spatial test at 30thminute after drinking black tea were not decreased significantly from frequency during spatial test after drinking black tea at 20thminute. Mean of frequency of beta wave in doing spatial test at 30thminute ($\overline{X}$= 14.79) was not different significantly from frequency of betawave at 20thminute ($\overline{X}$= 15.26).

2. The changing spectrum of Betawave during spatial test at Fz position

Table 4.12 Spectrum of Betawave during spatial test at Fz position

Spectrum of Beta wave during spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	10.75	6.10	0.96	0.349
Spatial test at 10th minute	19	9.18	3.96		
Spatial test at 0thminute	19	10.75	6.10	0.76	0.459
Spatial test at 20th minute	19	9.54	4.44		
Spatial test at 0thminute	19	10.75	6.10	-0.18	0.857
Spatial test at 30thminute	19	11.11	6.77		
Spatial test at 10th minute	19	9.18	3.96	-0.52	0.607
Spatial test at 20th minute	19	9.54	4.44		
Spatial test at 10th minute	19	9.18	3.96	-1.62	0.122
Spatial test at 30thminute	19	11.11	6.77		
Spatial test at 20th minute	19	9.54	4.44	-1.61	0.125
Spatial test at 30thminute	19	11.11	6.77		

According to data in table 4.12, p-value of the comparison spectrum of Beta wave in doing spatial test period at Fz position were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequencies of betawaves during spatial test at 10th and 20th minute were not significantly decreased from frequency of beta wave during spatial test at 0th minute before drinking black tea. Mean of frequency of betawaves during spatial test at 10th and 20thminute after drinking black tea ($\overline{X}$= 9.18 and 9.54,

respectively) was not significantly decreased from frequency of betawave during spatial test before drinking black tea at 0^{th} minute ($\overline{X}$= 10.75); however, frequency of betawave during spatial test at 30^{th} minute was not significantly increased from frequency of beta wave during spatial test at 0^{th} minute before drinking black tea. Mean of frequency of betawaves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 11.11) was not significantly increased from frequency at 0^{th} minute ($\overline{X}$= 10.75). Moreover, frequency of betawave during spatial test at 20^{th} minute was not significantly increased from frequency of betawaves during spatial test after drinking black tea at 10^{th} minute. Mean of frequency of betawaves in doing spatial test at 20^{th}minute after drinking black tea ($\overline{X}$= 9.54) was not increased from frequency of betawave during spatial test drinking black tea at 10^{th}minute ($\overline{X}$= 9.18). Finally, frequency of betawaves during spatial test at 30^{th} minute was not significantly increased from frequency of betawave during spatial test after drinking black tea at 10^{th} and 20^{th} minute. Mean of frequency of betawaves in doing spatial test at 30^{th}minutes after drinking black tea ($\overline{X}$= 11.11) was not different from frequency of betawaves during spatial test at 10^{th} and 20^{th}minute ($\overline{X}$= 9.18 and 9.54, respectively).

3. The changing frequency of betawave during spatial test at Cz positionw

Regarding to frequency of beta wave at Cz, p-value of frequency of Beta during doing spatial test period were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of betawaves during spatial test at 10^{th} and 20^{th} minute after drinking black tea were not significantly increase compared to during spatial test at 0^{th} minute before drinking black tea. Mean of frequency of betawaves during spatial test at 10^{th} and 20^{th} minute after drinking black tea ($\overline{X}$= 15.05 and 15.32, respectively) were not different from frequency of betawaves during spatial test at 0^{th}minute ($\overline{X}$= 14.68); however, frequency of betawaves during spatial test at 30^{th} minute after drinking black tea was not significantly different from frequency at 0^{th} minute or before drinking black tea. Mean of frequency of betawaves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 14.68) was not different from frequency of betawaves during doing spatial test at 0^{th}minute ($\overline{X}$= 14.68). Moreover, frequency of betawaves during spatial test at 20^{th} minute after drinking black tea was not significantly increased from frequency after drinking black tea at 10^{th} minute. Finally, frequency of

betawave during spatial test at 30th minute after drinking black tea was not significantly decreased from frequency at 10th and 20th minute after drinking black tea. Mean of frequency of betawave during spatial test at 30thminute after drinking black tea ($\overline{X}$= 14.68) was not decreased significantly from frequency of betawave during spatial test at 10thand 20th minute ($\overline{X}$= 15.05 and 15.32, respectively). The results are shown in table 4.13.

Table 4.13 Frequency of betawaves during spatial test at Cz position

Frequency of Betawave During Spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	14.68	0.89	0.49	0.628
Spatial test at 10th minute	19	15.05	1.31		
Spatial test at 0thminute	19	14.68	0.89	0.63	0.539
Spatial test at 20th minute	19	15.32	1.60		
Spatial test at 0thminute	19	14.68	0.89	-0.50	0.623
Spatial test at 30thminute	19	14.68	0.82		
Spatial test at 10th minute	19	15.05	1.31	0.09	0.931
Spatial test at 20th minute	19	15.32	1.60		
Spatial test at 10th minute	19	15.05	1.31	-0.92	0.369
Spatial test at 30thminute	19	14.68	0.82		
Spatial test at 20th minute	19	15.32	1.60	-1.36	0.191
Spatial test at 30thminute	19	14.68	0.82		

4. The changing of spectrum of betawave during spatial test at Cz position.

Table 4.14 Spectrum of betawaves during spatial test at Cz position

Spectrum of Betawave During Spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	9.21	3.61	0.49	0.628
Spatial test at 10th minute	19	8.74	3.31		
Spatial test at 0thminute	19	9.21	3.61	0.63	0.539
Spatial test at 20th minute	19	8.68	3.08		
Spatial test at 0thminute	19	9.21	3.61	-0.50	0.623
Spatial test at 30thminute	19	9.76	3.98		
Spatial test at 10th minute	19	8.74	3.31	0.09	0.931
Spatial test at 20th minute	19	8.68	3.08		
Spatial test at 10th minute	19	8.74	3.31	-0.92	0.369
Spatial test at 30thminute	19	9.76	3.98		
Spatial test at 20th minute	19	8.68	3.08	-1.36	0.191
Spatial test at 30thminute	19	9.76	3.98		

According to data in table 4.14, analysis data by pair-t-test, p-value of spectrum of betawaves during spatial test period, at Cz position, were more than significant level 0.05. This means null hypothesis (H_0) cannot be accepted. Spectrum of betawaves during spatial test at 10thand 20th minute after drinking black tea were not decreased significantly compared to doing spatial test before drinking black tea at 0th minute. Mean of spectrum of betawaves during spatial test at 10th and 20th minute after drinking black tea ($\overline{X}$= 8.74 and 8.68, respectively) were not decreased from spectrum of betawaves during spatial test before drinking black tea at 0thminute ($\overline{X}$= 9.21); nevertheless, Spectrum of betawave during spatial test at 30th minute after drinking black tea was not increased significantly compared to doing spatial test before drinking black tea at 0th minute. Mean of spectrum of betawaves during spatial test at 30thminute after

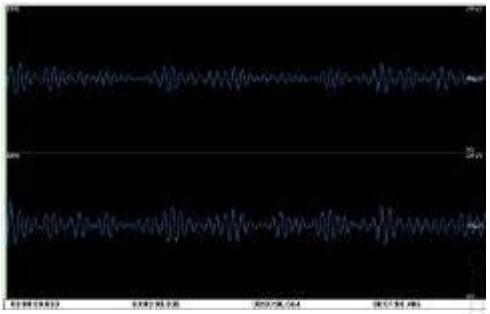
drinking black tea ($\overline{X}$= 9.76) was not different from spectrum of betawave during spatial test before drinking black tea at 0thminute ($\overline{X}$=8.74). Spectrum of betawaves during spatial test at 20th and 30th minute after drinking black tea was not increased significantly compare to after drinking black tea at 10th minute. Mean of spectrum of betawaves during spatial test at 20th and 30th minute after drinking black tea ($\overline{X}$= 8.68 and 9.76, respectively) was not increased from spectrum of betawaves during spatial test after drinking black tea at 10th minute ($\overline{X}$=9.76). Finally, spectrum of betawaves during spatial test at 30th minute after drinking black tea was not increased significantly compared to after drinking black tea at 20th minute. Mean of spectrum of betawaves during spatial test at 30th minute after drinking black tea ($\overline{X}$= 9.76) was not increased from spectrum of betawaves during spatial test after drinking black tea at 20th minutes ($\overline{X}$= 8.68).

4.2.3 The changing frequency and spectrum of Alpha wave

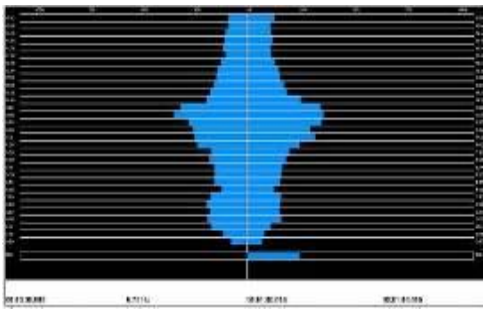
This kind of frequency is specific only to frequency in range 8 - 12 Hz or alpha wave range. The result was collected from frequency 8 - 12 Hz. The analysis of data is to compare frequency and spectrum of alpha waves that change in the time of eyes closed, eyes open before to after drinking black tea, frequency and spectrum of alpha waves that change during spatial test at 0th, 10th, 20thand 30thminute. The data was analysed by pair-t-test, significant at p-value <0.05.

4.2.3.1 The changing frequency of alpha waves in eyes closed period.

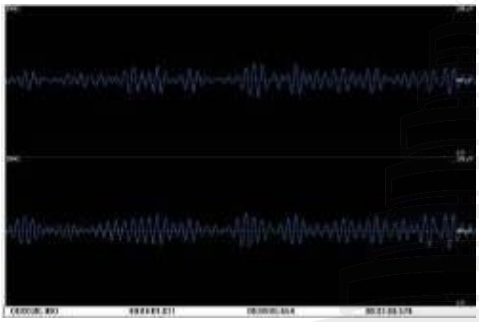
The result of this part is to find frequency and spectrum of alpha wave during eyes closed period before drinking black tea compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme as shown in Figure 4.16.



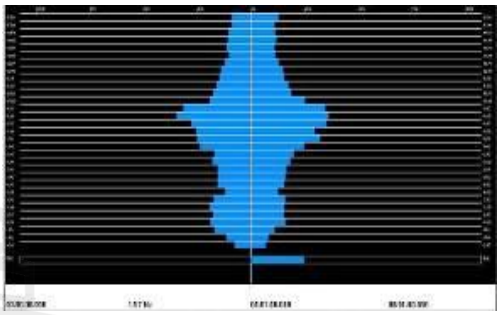
Brainwaves before drinking black tea



Frequency and spectrum before drinking black tea



Brainwaves after drinking black tea



Frequency and spectrum after drinking black tea

Figure 4.17 Picture shows frequency and spectrum of alpha wave during eyes closed period

According to the data in Figure 4.15, alpha wave data (the left side pictures) were computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum of alpha wave at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.15.

Table 4.15 Frequency and spectrum of alpha waves during eyes closed period

Frequency and Spectrum of Alpha wave Eye close	n	$\overline{X}$	SD	t	*p*
Frequency Before drinking at Fz	19	10.24	0.99	-0.92	0.369
Frequency After drinking at Fz	19	10.46	0.91		
Spectrum Before drinking at Fz	19	27.61	15.93	0.26	0.795
Spectrum After drinking at Fz	19	26.56	16.22		
Frequency Before drinking at Cz	19	10.39	0.95	-0.87	0.399
Frequency After drinking at Cz	19	10.53	0.86		
Spectrum Before drinking at Cz	19	30.92	20.76	0.22	0.826
Spectrum After drinking at Cz	19	30.04	21.09		

According to data in table 4.15, p-value of frequency and spectrum of alpha waves during eyes closed period, at Fz and Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of alpha waves at Fz and Cz position during eyes closed, after drinking black tea, were not increased significantly before drinking black tea. Mean of frequency of alpha waves during eyes closed at Fz and Cz position after drinking black tea ($\overline{X}$= 10.46 and 10.53, respectively) was not increased significantly from frequency and spectrum of alpha wave before drinking black tea ($\overline{X}$= 10.24 and 10.39, respectively). Spectrum of alpha waves at Fz and Cz position during eyes closed, after drinking black tea, were not decreased significantly before drinking black tea. Mean of spectrum of alpha waves during eyes closed at Fz and Cz position after drinking black tea ($\overline{X}$= 26.56, 30.04, respectively) was not decreased significantly from spectrum before drinking black tea ($\overline{X}$= 27.61, 30.92, repectively).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the figure 4.17. The 3D has shown brain waves in area of alpha waves in both left (left side of picture) and right side (right side of picture) of the brain in alpha wave frequency.

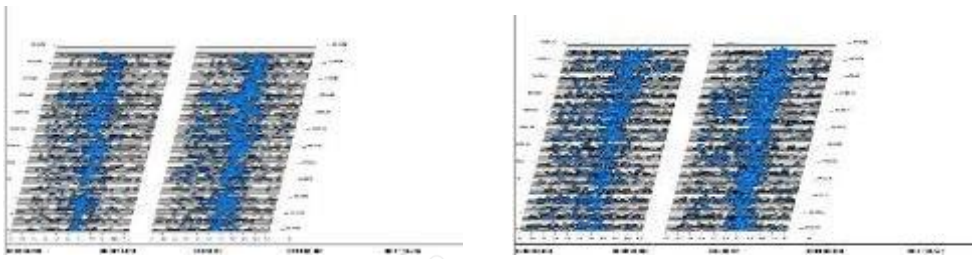


Figure 4.18 3D-Landscape-Darstellung in alpha wave frequency during eyes closed period

4.2.3.2 The changing frequency of alpha waves in period of eyes open.

The result of this part is to find frequency and spectrum of alpha wave in eyes open period before drinking black tea compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme as shown in figure 4.19.

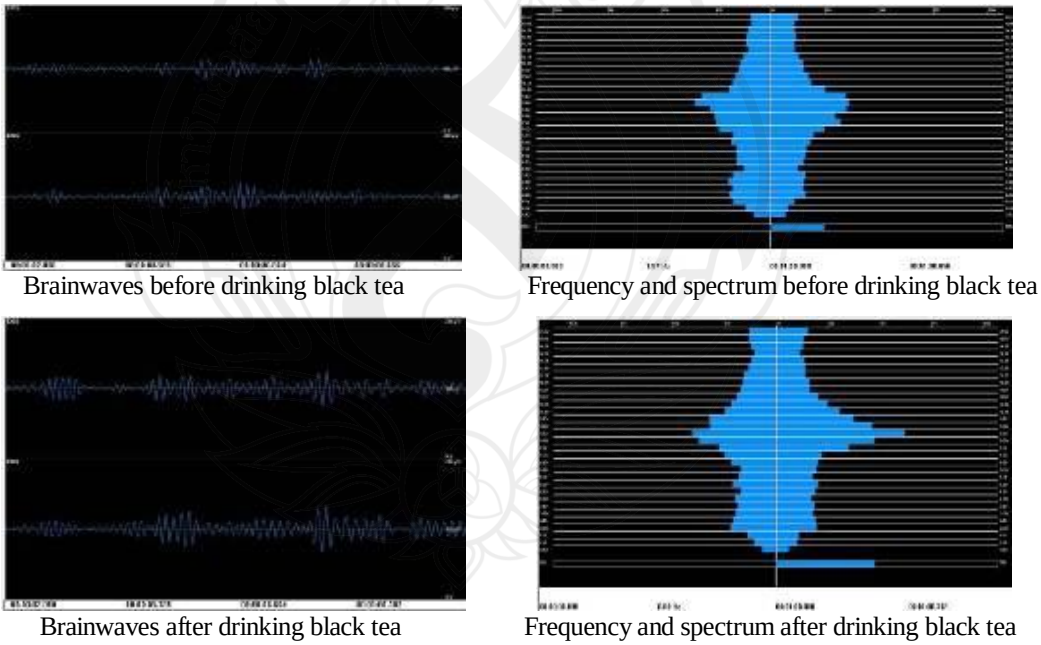


Figure 4.19 Picture shows frequency and spectrum of alpha waves during eyes open period

According to the data in figure 4.19, alpha wave data (the left side pictures) were computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum of alpha waves at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.16.

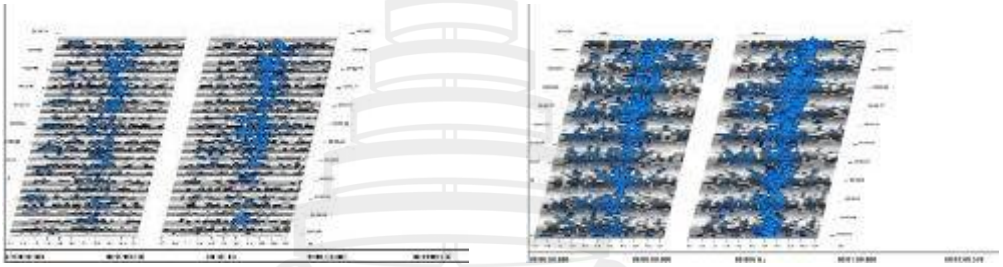
Table 4.16 Table shows frequency and spectrum of alpha waves during eyes open period

Frequency and Spectrum of Alpha wave during Eye open	**n**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	10.07	1.29	-0.22	0.830
Frequency After drinking at Fz	19	10.14	1.43		
Spectrum Before drinking at Fz	19	11.72	7.25	-0.46	0.648
Spectrum After drinking at Fz	19	12.24	8.09		
Frequency Before drinking at Cz	19	10.54	1.09	1.62	0.122
Frequency After drinking at Cz	19	9.97	1.17		
Spectrum Before drinking at Cz	19	12.77	8.43	-0.23	0.817
Spectrum After drinking at Cz	19	13.25	14.32		

According to data in table 4.16, p-value of frequency and spectrum of alpha waves during eyes open period, at Fz and Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency and spectrum of alpha waves during eyes open at Fz and spectrum of alpha wave at Cz position were not increased significantly between before and after drinking black tea. Mean of frequency and spectrum of alpha waves during eyes closed at Fz and spectrum of alpha waves at Cz position after drinking black tea ($\overline{X}$= 10.14, 12.14 and 13.25 respectively) was not increased significantly from frequency and spectrum at Fz and spectrum at Cz before drinking black tea ($\overline{X}$= 10.07, 11.72 and 12.77 respectively). Spectrum of alpha waves during eyes closed at Cz position was not decreased significantly between, before, and after drinking black tea. Mean of spectrum of alpha waves during eyes open period at Cz

after drinking black tea ($\overline{X}$= 9.97) was not decreased significantly from spectrum before drinking black tea ($\overline{X}$= 10.54).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the figure 4.19. The 3D has shown brain wave in area of alpha waves in both left (left side of picture) and right sides (right side of picture) of the brain in alpha wave frequency. It's noticeable that most change of alpha waves are on the right side of the brain.

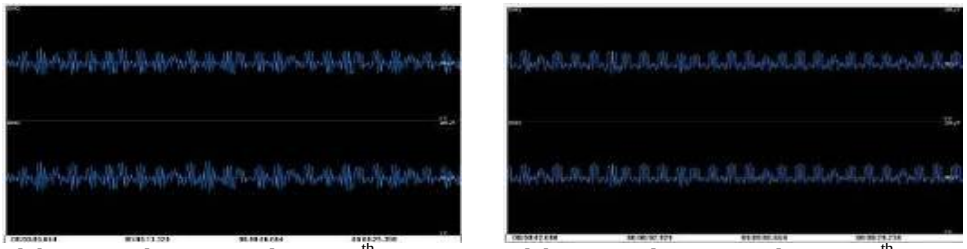


Brainwave before drinking black tea Brainwave after drinking black tea

Figure 4.20 Picture of 3D-Landscape-Darstellung in alpha wave frequency during eyes open period

4.2.3.3 The changing of brainwave frequency and spectrum of alpha wave during doing spatial test at Fz at Cz postion.

The result of this part is to find frequency and spectrum of Alpha waves on screen of Brain Actor during doing spatial test at the time 0 minute and doing spatial test with drinking black tea at the time 10, 20 and 30 minutes. Alpha wave on screen of Brain Actor (Figure 4.20) was computed by mind mirror programme (Figure 4.21). All data was analysed by pair-t-test, significant level is 0.05.



Alpha waves during spatial test at 0th minute

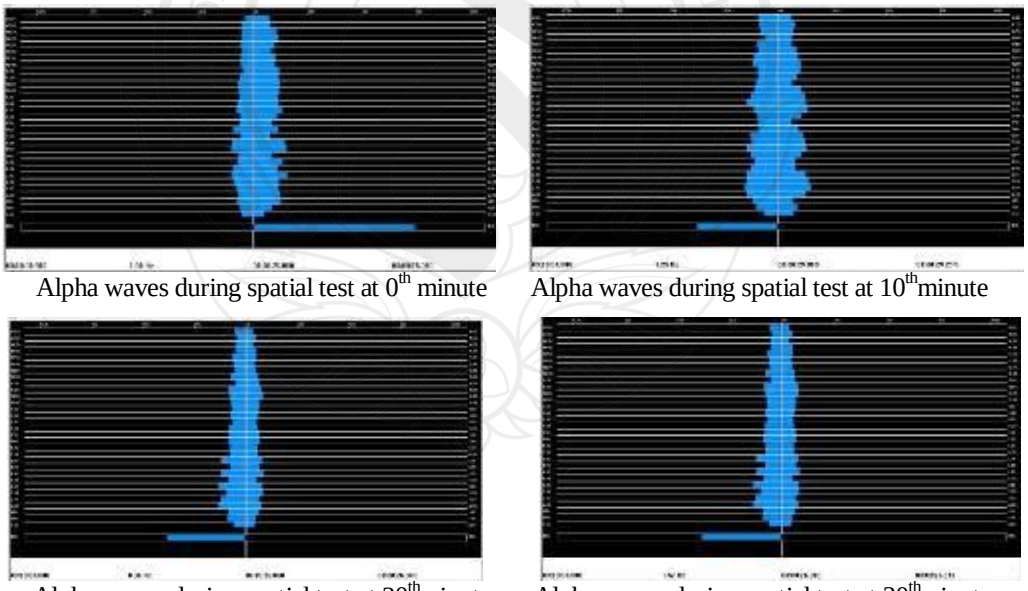
Alpha waves during spatial test at 10th minute

Alpha waves during spatial test at 20th minute

Alpha waves during spatial test at 30th minute

Figure 4.21 Picture shows Alpha waves during spatial test period on Brain Actor

Concerning all brainwaves from figure 4.21, the data can be computed to find frequencies and spectrums change by mind mirror programme as the figure 4.22.



Alpha waves during spatial test at 0th minute

Alpha waves during spatial test at 10th minute

Alpha waves during spatial test at 20th minute

Alpha waves during spatial test at 30th minute

Figure 4.22 Frequency and spectrum of alpha waves during spatial on mind mirror screen

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the figure 4.22. The 3D has shown not much brain wave activity in areas of both left (left side of picture) and right sides (right side of picture) of the brain in alpha wave frequency.

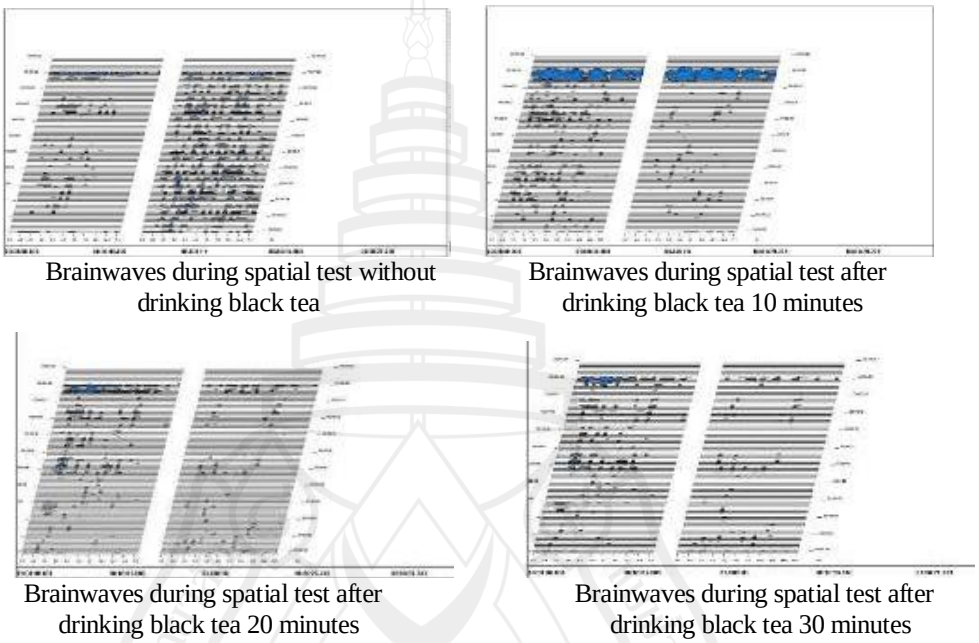


Figure 4.23 3D-Landscape-Darstellung of alpha waves frequency during spatial test peroid

1. The changing frequency of Alpha waves during spatial test at Fz position.

Table 4.17 Frequency of Alpha waves during spatial test at Fz position

Alpha wave during Spatial test at Fz position	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0^{th} minute	19	9.41	1.24	-3.13	**0.006
Spatial test at 10^{th} minute	19	10.12	1.23		
Spatial test at 0^{th}minute	19	9.41	1.24	-2.62	*0.017

Table 4.17 (continued)

Alpha wave during Spatial test at Fz position	n	$\overline{X}$	SD	t	*p*
Spatial test at 20th minute	19	9.92	1.29		
Spatial test at 0thminute	19	9.41	1.24	-2.74	*0.013
Spatial test at 30thminute	19	9.99	1.28		
Spatial test at 10th minute	19	10.12	1.23	0.32	0.750
Spatial test at 20th minute	19	9.92	1.29		
Spatial test at 10th minute	19	10.12	1.23	0.10	0.921
Spatial test at 30thminute	19	9.99	1.28		
Spatial test at 20th minute	19	9.92	1.29	-0.20	0.841
Spatial test at 30thminute	19	9.99	1.28		

According to data in table 4.17, the data from pair-t-test, p-value of frequency of alpha waves during spatial test period, at Fz position, were less than significant level 0.05 during spatial test 0thand 10thminute, 0thand 20thminute and 0thand 30thminute. Null hypothesis (H_0) can be accepted. Frequency of alpha wave during spatial test at 10th, 20thand 30thminute after drinking black tea showed significant increase from doing spatial test before drinking black tea at 0thminute. Mean of frequency of alpha waves during spatial test at 10th, 20thand 30thminutes after drinking black tea ($\overline{X}$= 10.12, 9.92, 9.99, respectively) was increased significantly from frequency of alpha waves during spatial test before drinking black tea at 0 minute ($\overline{X}$= 9.41). Nevertheless, p-value of frequency of alpha waves during spatial test period at Fz position were more than significant level 0.05 during spatial test 10thto 20thminutes, 10th to 30thminutes and 20thto 30thminutes. Null hypothesis cannot be accepted. Mean of frequency of alpha wave during spatial test at 20thand 30thminutes after drinking black tea ($\overline{X}$= 9.92, 9.99, respectively) was not significantly increased from frequency of alpha waves during spatial test after drinking black tea at 10thminutes ($\overline{X}$= 10.12). Mean of frequency of alpha wave during spatial test at 30thminutes after drinking black tea ($\overline{X}$= 9.99, respectively) also was not significantly increased from frequency of alpha waves during spatial test after drinking black tea at 20thminutes ($\overline{X}$= 9.92).

2. The changing spectrum of alpha wave during spatial test at Fz position

Regarding to spectrum of alpha wave at Fz position, p-value of spectrum of alpha wave during spatial test period, at Fz position, were found less than significant level 0.05 during spatial test between $10^{th}$and 30^{th}minute. Null hypothesis (H_0) can be accepted. Spectrum of alpha waves during spatial test at 30^{th}minute after drinking black tea showed significant increase from doing spatial test after drinking black tea at 10^{th}minute. Mean of spectrum of alpha wave during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 11.11) was significantly increased from spectrum of alpha waves during spatial test after drinking black tea at 10^{th}minute ($\overline{X}$= 9.18). Nevertheless, the statistic significant value of comparison spectrum of alpha waves during spatial test period at Fz position were found more than significant level 0.05 during spatial test $0^{th}$to 10^{th}minute, $0^{th}$to 20^{th}minute, $0^{th}$to 30^{th}minute, 10^{th} to 20^{th} minute and $20^{th}$and 30^{th} minute. This means null hypothesis cannot be accepted. Mean of spectrum of alpha waves during spatial test at 10^{th} and 20^{th} after drinking black tea ($\overline{X}$= 9.18 and 9.54, respectively) was not significantly decreased from spectrum of alpha waves during spatial test before drinking black tea at 0^{th}minutes ($\overline{X}$= 10.75). Mean of spectrum of alpha waves during spatial test at 30^{th} after drinking black tea ($\overline{X}$=11.11, respectively) was not significantly increased from spectrum of alpha waves during spatial test before drinking black tea at 0^{th}minutes ($\overline{X}$= 10.75). Mean of spectrum of alpha waves during spatial test at 20^{th} minute after drinking black tea ($\overline{X}$= 9.54, respectively) was not significantly increased from spectrum of alpha waves during spatial test before drinking black tea at 10^{th}minutes ($\overline{X}$= 9.18). Mean of spectrum of alpha waves during spatial test at 30^{th} minute after drinking black tea ($\overline{X}$= 11.11) was not significantly increased from spectrum of alpha waves during spatial test before drinking black tea at 20^{th}minutes ($\overline{X}$= 9.54). The results are shown in table 4.18.

Table 4.18 Spectrum of alpha waves during spatial test at Fz position

Spectrum of Alpha wave during spatial test at Fz	n	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	10.75	6.10	0.75	0.462
Spatial test at 10th minute	19	9.18	3.96		
Spatial test at 0thminute	19	10.75	6.10	0.40	0.695
Spatial test at 20th minute	19	9.54	4.44		
Spatial test at 0thminute	19	10.75	6.10	-0.46	0.653
Spatial test at 30thminute	19	11.11	6.77		
Spatial test at 10th minute	19	9.18	3.96	-0.62	0.540
Spatial test at 20th minute	19	9.54	4.44		
Spatial test at 10th minute	19	9.18	3.96	-2.51	*0.022
Spatial test at 30thminute	19	11.11	6.77		
Spatial test at 20th minute	19	9.54	4.44	-1.44	0.166
Spatial test at 30thminute	19	11.11	6.77		

3. The changing frequency of alpha waves during spatial test at Cz position

Table 4.19 Frequency of alpha waves during spatial test at Cz position

Frequency of Alpha wave During spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	10.39	1.17	-0.07	0.948
Spatial test at 10th minute	19	10.42	1.07		
Spatial test at 0thminute	19	10.39	1.17	0.31	0.757
Spatial test at 20th minute	19	10.29	1.06		
Spatial test at 0thminute	19	10.39	1.17	-0.28	0.786
Spatial test at 30thminute	19	10.50	1.01		
Spatial test at 10th minute	19	10.42	1.07	0.39	0.699
Spatial test at 20th minute	19	10.29	1.06		

Table 4.19 (continued)

Frequency of Alpha wave During spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 10th minute	19	10.42	1.07	-0.21	0.832
Spatial test at 30thminute	19	10.50	1.01		
Spatial test at 20th minute	19	10.29	1.06	-0.69	0.501
Spatial test at 30thminute	19	10.50	1.01		

According to data in table 4.19, p-value of frequency of alpha waves during spatial test period, at Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of alpha waves during spatial test at 0thminute or before drinking black tea showed no difference compared to doing spatial test after drinking black tea at 10th, 20thand 30thminutes. Mean of frequency of alpha waves during spatial test at 20thminute after drinking black tea ($\overline{X}$= 10.29) was not significantly decreased from frequency of alpha waves before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 10.39) and mean of frequency of alpha waves during spatial test at 10th and 30thminutes after drinking black tea ($\overline{X}$= 10.42 and 10.50, respectively) was not significantly increased from frequency of alpha waves before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 10.39). Mean of frequency of alpha waves during spatial test at 20thminute after drinking black tea ($\overline{X}$= 10.29) was not decreased significantly from frequency of alpha wave during spatial test after drinking black tea at 10thminute ($\overline{X}$= 10.42). Mean of frequency of alpha waves during spatial test at 30thminute after drinking black tea ($\overline{X}$=10.50) was not significantly increased from frequency of alpha waves during spatial test after drinking black tea at 10thminute ($\overline{X}$= 10.42). Mean of frequency of alpha waves during spatial test at 30thminute after drinking black tea ($\overline{X}$= 10.50) was not significantly increased from frequency of alpha waves during spatial test after drinking black tea at 20thminute ($\overline{X}$= 10.29).

4. The changing spectrum of alpha waves during spatial test at Cz position.

Regarding to spectrum of alpha wave at Cz position, p-value of spectrums of alpha waves during spatial test period, at Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrum of alpha waves during spatial test at 0^{th}minute or before drinking black tea showed no difference significantly compared to doing spatial test after drinking black tea at 10^{th}, $20^{th}$and 30^{th}minute. Mean of spectrum of alpha waves during spatial test at 10^{th} and 20^{th}minute after drinking black tea ($\overline{X}$= 8.66 and 7.81, respectively) was not significantly decreased from spectrum of alpha wave during spatial test 0^{th}minute or before drinking black tea ($\overline{X}$= 9.10). Mean of spectrum of alpha waves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 9.10) was not significantly changed from spectrum of alpha waves during spatial test 0^{th}minute ($\overline{X}$= 9.10). Mean of spectrum of alpha waves during spatial test at 20^{th}minute after drinking black tea ($\overline{X}$= 7.81) was not significantly decreased from spectrum of alpha waves during spatial test after drinking black tea at 10^{th} minute ($\overline{X}$= 8.66). Mean of spectrum of alpha waves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 9.10, respectively) was not significantly increased from spectrum of alpha waves during spatial test after drinking black tea at 10^{th} minute ($\overline{X}$= 8.66). Mean of spectrum of alpha waves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 9.10) was not significantly increased from spectrum during spatial test at 20^{th} minutes ($\overline{X}$= 7.81) after drinking black tea. The results are shown in table 4.20

Table 4.20 Spectrum of alpha waves during spatial test at Cz position

Spectrum of Alpha wave during spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0^{th} minute	19	9.10	4.14	0.42	0.683
Spatial test at 10^{th} minute	19	8.66	4.77		
Spatial test at 0^{th}minute	19	9.10	4.14	1.67	0.112
Spatial test at 20^{th} minute	19	7.81	3.38		
Spatial test at 0^{th}minute	19	9.10	4.14	0.00	1.000

Table 4.20 (continued)

Spectrum of Alpha wave during spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 30th minute	19	9.10	4.88		
Spatial test at 10th minute	19	8.66	4.77	1.15	0.265
Spatial test at 20th minute	19	7.81	3.38		
Spatial test at 10th minute	19	8.66	4.77	-0.40	0.694
Spatial test at 30th minute	19	9.10	4.88		
Spatial test at 20th minute	19	7.81	3.38	-1.86	0.079
Spatial test at 30th minute	19	9.10	4.88		

4.2.4 The changing of frequency and spectrum of Theta wave

This kind of frequency is specific only frequencies range 4 - 7 Hz or Theta wave range. The result was collected from frequency 4 - 7 Hz. The analysis of data is to compare frequency and spectrum of Theta waves that change in the time of eyes closed, eyes open, before, to, after, drinking black tea, frequency and spectrum of Theta waves that change during spatial test at 0th, 10th, 20th and 30thminute. The data was analysed by pair-t-test, significant at 0.05

4.2.4.1 The changing frequency of Theta waves during eyes closed period.

The result of this part is to find frequency and spectrum of Theta waves during eyes closed period before drinking black compare to after drinking black tea by Brain Actor. All data was computed by mind mirror programme as shown in figure 4.23.

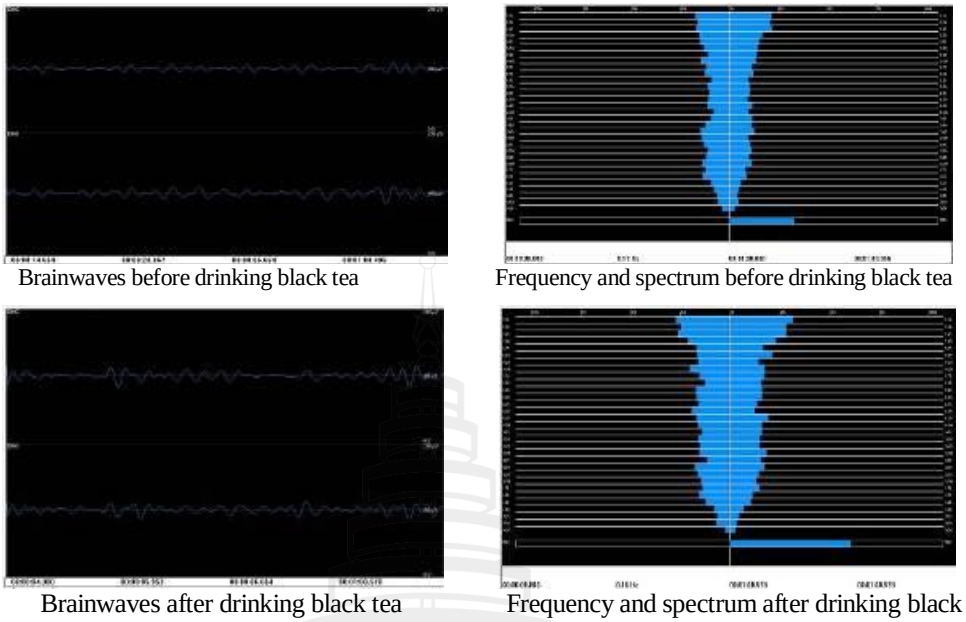


Figure 4.24 Frequency and spectrum of Theta waves during eyes closed period

According to the data in figure 4.24, brainwave data (the left side pictures) were computed by mind mirror programme (the right side pictures). The results were data from both Fz (the left side of screen in mind mirror) and Cz positions (the right side of screen in mind mirror). The comparison data was analysed by pair-t-test and shown as in the table 4.21

Table 4.21 Frequency and spectrum of Theta waves during eyes closed period

Frequency and Spectrum of Theta wave (Eye close)	**n**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	5.76	0.90	-0.67	0.509
Frequency After drinking at Fz	19	5.87	0.88		
Spectrum Before drinking at Fz	19	10.36	4.86	0.31	0.762
Spectrum After drinking at Fz	19	10.09	5.21		
Frequency Before drinking at Cz	19	5.94	0.87	0.81	0.431
Frequency After drinking at Cz	19	5.78	0.96		

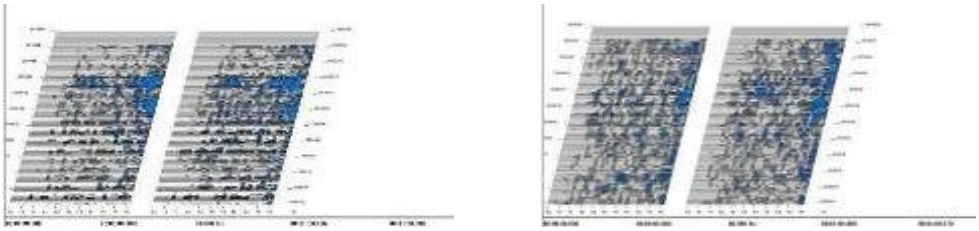
Table 4.21 (continued)

Frequency and Spectrum of Theta wave (Eye close)	n	$\overline{X}$	SD	t	*p*
Spectrum Before drinking at Cz	19	9.43	4.80	2.42	0.026*
Spectrum After drinking at Cz	19	8.44	4.47		

Note. * $p < .05$

According to data in table 4.24, p-value of spectrum of Theta waves during eyes closed period, at Cz, position were less than significant level 0.05. Null hypothesis (H_0) can be accepted. Spectrum of Theta waves during eyes closed after drinking black tea showed decrease significantly from after drinking. Mean of spectrum of Theta waves during eyes closed period after drinking black tea ($\overline{X}$= 8.44) was significantly decreased from spectrum of Theta waves before drinking black tea ($\overline{X}$= 9.43). Nevertheless, p-value of frequency and spectrum during eyes closed period at Fz and frequency at Cz position were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrum of Theta waves at Fz and frequency of Theta waves at Cz position during eye closed after drinking black tea were not significantly decreased from before drinking black tea. Mean of spectrum, at Fz, and frequency of Theta waves, at Cz, during eyes closed, after drinking black tea ($\overline{X}$= 10.09 and 5.78, respectively) was not decreased significantly from and spectrum, at Fz, and frequency, at Cz, before drinking black tea ($\overline{X}$= 10.36 and 5.94, respectively). Frequency of Theta waves at Fz position, during eyes closed, after drinking black tea were not significantly increased from before drinking black tea. Mean of frequency of Theta waves, at Fz, during eyes closed, after drinking black tea ($\overline{X}$= 5.87) was not significantly increased from and frequency, at Fz, before drinking black tea ($\overline{X}$= 5.76).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.24. The 3D has shown brain waves in area of alpha waves in both left (left side of picture) and right side (right side of picture) of brain in theta waves frequency.

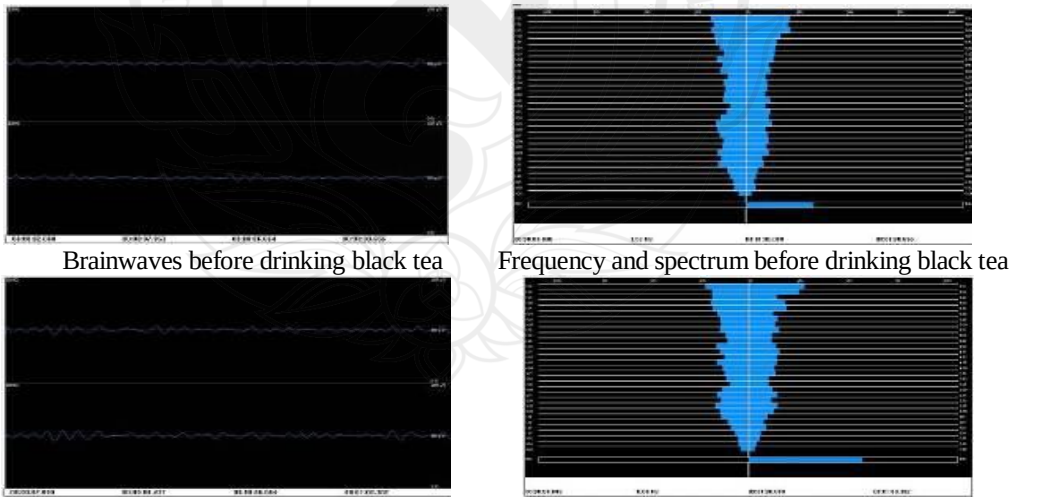


Brainwave before drinking black tea Brainwave after drinking black tea

Figure 4.25 3D-Landscape-Darstellung in theta waves frequency during eyes closed period

4.2.4.2 The changing frequency and spectrum of Theta wave during eye open period.

The result of this part is to find frequency and spectrum in screen of Brain Actor of eyes open in the time before drinking black compared to after drinking black tea. After detection of brainwaves, all brainwaves had to be computed from mind mirror programme. The results are shown as the Figure 4.25. The results in this part compare frequency and spectrum change before, to, after, drinking black tea during eyes open period at Fz and Cz position.



Brainwaves before drinking black tea Frequency and spectrum before drinking black tea

Brainwaves after drinking black tea Frequency and spectrum after drinking black tea

Figure 4.26 Picture shows frequency and spectrum of Theta waves during eyes open period

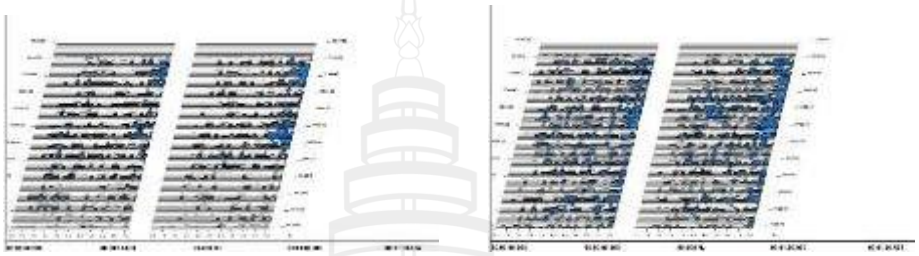
According to the data in figure 4.26, Theta wave data (the left side pictures) was computed by mind mirror programme (the right side pictures) in order to find frequency and spectrum of Theta waves at Fz (Left side of mid mirror screen) and Cz position (Right side of mind mirror screen). The comparison data was analysed by pair-t-test and shown as in the table 4.22.

Table 4.22 Frequency and spectrum of Theta waves during eyes open period

Frequency and Spectrum of Theta wave during eye open	**n**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	5.22	1.00	-1.56	0.136
Frequency After drinking at Fz	19	5.70	1.14		
Spectrum Before drinking at Fz	19	9.58	4.16	0.12	0.906
Spectrum After drinking at Fz	19	9.49	4.97		
Frequency Before drinking at Cz	19	5.73	0.91	-0.49	0.627
Frequency After drinking at Cz	19	5.86	0.84		
Spectrum Before drinking at Cz	19	6.93	2.84	-0.05	0.963
Spectrum After drinking at Cz	19	6.96	3.80		

According to data in table 4.22, p-value of frequency and spectrum of Theta waves during eyes open period at Fz and Cz position were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of Theta waves at Fz and Cz and spectrum of Theta waves at Cz during eyes open period showed no significant increase between before and after drinking black tea. Mean of frequency of Theta waves at Fz and Cz and spectrum of Theta wave at Cz during eyes open period after drinking black tea ($\overline{X}$= 5.70, 5.86 and 6.96, respectively) was not significantly increased from before drinking black tea ($\overline{X}$= 5.22, 5.73 and 6.93 respectively). Spectrum of Theta waves at Fz during eye open period showed no significant decrease between before and after drinking black tea. Mean of spectrum of Theta waves during eyes open period at Fz, during eyes open period, after drinking black tea, ($\overline{X}$= 9.49) was not decreased significantly from before drinking black tea ($\overline{X}$= 9.58).

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the Figure 4.24. The 3D has shown brain waves in areas of alpha wave in both left (left side of picture) and right sides (right side of picture) of the brain in theta wave frequency.

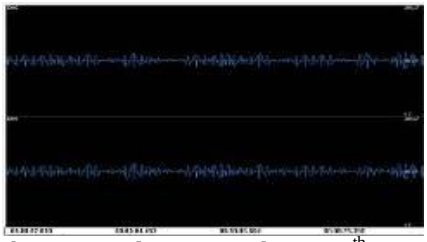


Brainwave before drinking black tea Brainwave after drinking black tea

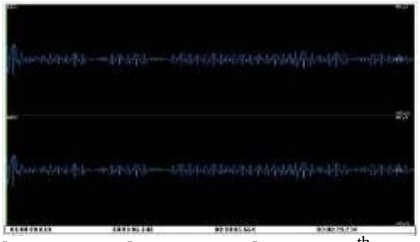
Figure 4.27 3D-Landscape-Darstellung in Theta waves frequency during eyes open period

4.2.4.3 The changing frequency and spectrum of Theta wave during doing spatial test at Fz at Cz postion.

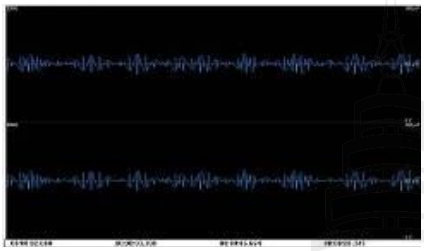
The result of this part is to find frequency and spectrum of Theta waves on screen of Brain Actor during spatial test at the time 0 minute and doing spatial test with drinking black tea at the time 10, 20 and 30 minutes. Theta waves on screen of Brain Actor (Figure 4.28) was computed by mind mirror programme (Figure 4.29). The data was analysed by pair-t-test, significant level is $p<0.05$.



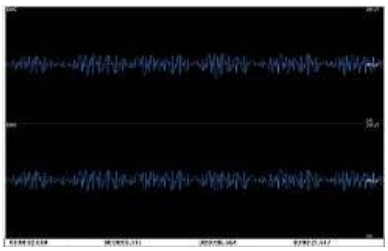
Theta waves during spatial test at 0thminute



Theta waves during spatial test at 10thminute



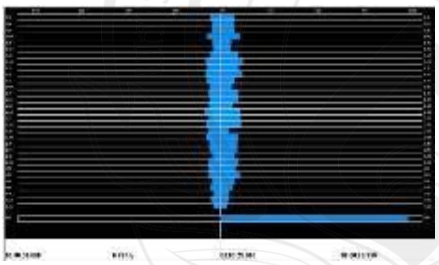
Theta waves during spatial test at 20thminute



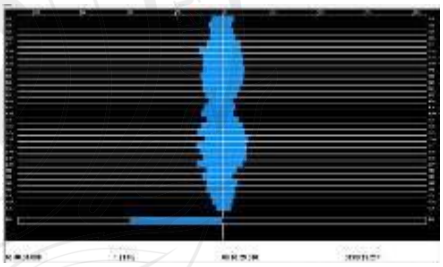
Theta waves during spatial test at 30thminute

Figure 4.28 Frequency of Theta during spatial test period

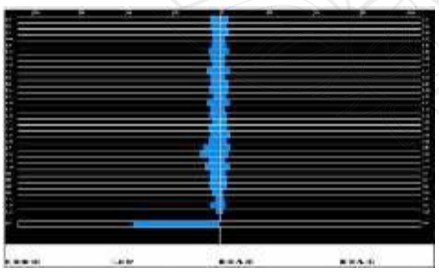
Concerning all brainwaves from figure 4.28, the data can be computed to find frequencies and spectrums change by mind mirror programme as in Figure 4.28.



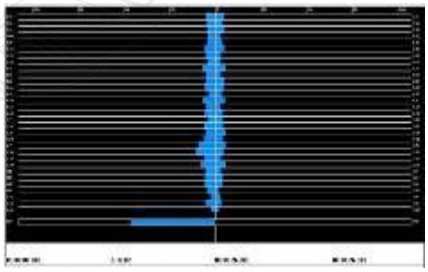
Theta waves during spatial test at 0thminute



Theta waves during spatial test at 10thminute



Theta waves during spatial test at 20thminute



Theta waves during spatial test at 30thminute

Figure 4.29 Frequencies and spectrums of Theta waves during spatial test on mind mirror screen

The data from screen on brain actor and mind mirror was also computed by 3D-Landscape- Darstellung as shown in the figure 4.30. The 3D has shown not much brain waves in area of both left (left side of picture) and right sides (right side of picture) of the brain in theta waves frequency.

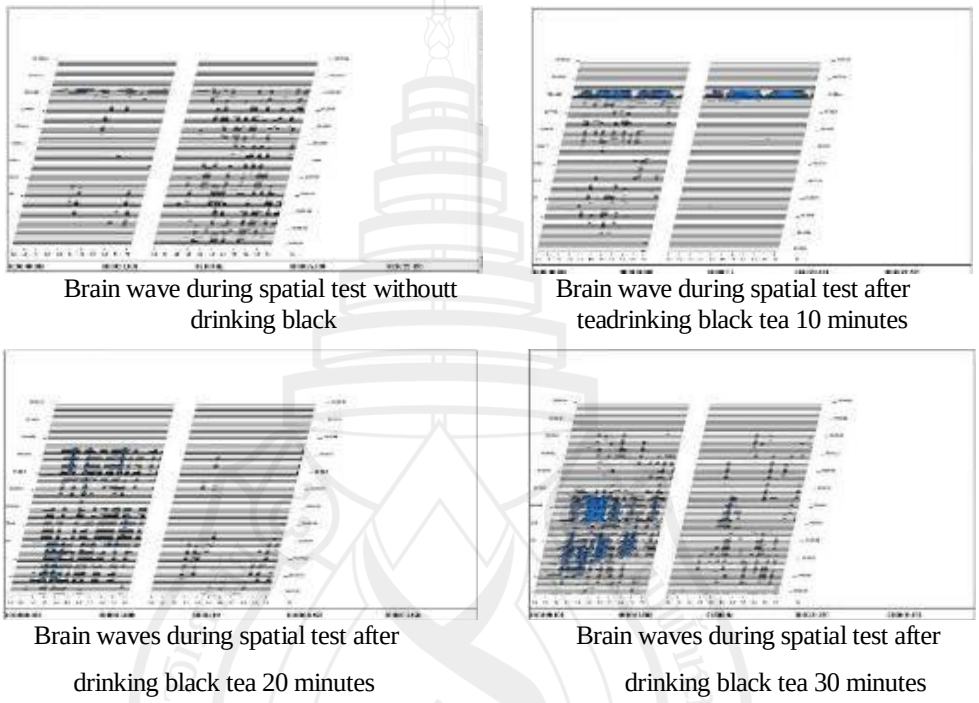


Figure 4.30 3D-Landscape-Darstellung of Theta waves frequency during spatial test

1. The changing frequency of Theta waves during spatial test period.

Regarding to frequency of Theta waves during doing spatial test, p-value of Theta waves during doing spatial test period, at Fz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of Theta waves doing spatial test at 30^{th}minute after drinking black tea showed no significant increase of frequency of Theta wave 0^{th}, $10^{th}$and 20^{th}minute, respectively. Mean of frequency of Theta wave during spatial test at 30^{th} after drinking black tea ($\overline{X}$= 5.03, 4.96, 5.10, respectively) was not significantly increased from frequency of Theta waves before drinking black tea at 0^{th} minute ($\overline{X}$= 5.03) and during spatial test at 10^{th} and 20^{th} minute ($\overline{X}$= 5.03 and 4.96 respectively). Frequency of Theta waves during spatial test at

20th minute after drinking black tea showed no significant decreased frequency of Theta waves at 0th and 10th minute. Mean of frequency of Theta waves during spatial test at 20th after drinking black tea ($\overline{X}$=4.96) was not significantly decreased from 0th and 10th minute ($\overline{X}$= 5.03 and 5.03 respectively). Frequency of Theta waves during spatial test at 10th minute after drinking black tea showed no significantly change from frequency of Theta waves at 0th minute. Mean of frequency of Theta waves during spatial test after drinking black tea at 10th minute ($\overline{X}$= 5.03) did not significantly change from frequency of Theta waves during spatial test at 0th minute ($\overline{X}$= 5.03). The results are shown in table 4.23

Table 4.23 Table shows frequency of Theta waves during spatial test at Fz position

Theta wave during Doing spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	5.03	0.96	0.00	1.000
Spatial test at 10th minute	19	5.03	0.69		
Spatial test at 0th minute	19	5.03	0.96	0.27	0.794
Spatial test at 20th minute	19	4.96	0.59		
Spatial test at 0th minute	19	5.03	0.96	1.08	0.293
Spatial test at 30th minute	19	5.10	0.80		
Spatial test at 10th minute	19	5.03	0.69	0.32	0.751
Spatial test at 20th minute	19	4.96	0.59		
Spatial test at 10th minute	19	5.03	0.69	-0.29	0.776
Spatial test at 30th minute	19	5.10	0.80		
Spatial test at 20th minute	19	4.96	0.59	-0.71	0.485
Spatial test at 30th minute	19	5.10	0.80		

2. The changing spectrum of Theta waves during doing spatial test at Fz position

Table 4.24 Table shows spectrum of Theta waves during spatial test at Fz position

Spectrum of Theta wave during spatial test at Fz	N	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	10.58	6.48	0.46	0.652
Spatial test at 10th minute	19	9.83	4.36		
Spatial test at 0thminute	19	10.58	6.48	-0.61	0.547
Spatial test at 20th minute	19	12.06	9.40		
Spatial test at 0thminute	19	10.58	6.48	-0.73	0.477
Spatial test at 30thminute	19	12.06	8.03		
Spatial test at 10th minute	19	9.83	4.36	0.01	0.993
Spatial test at 20th minute	19	12.06	9.40		
Spatial test at 10th minute	19	9.83	4.36	-0.38	0.708
Spatial test at 30thminute	19	12.06	8.03		
Spatial test at 20th minute	19	12.06	9.40	-0.39	0.702
Spatial test at 30thminute	19	12.06	8.03		

According to data in table 4.24, p-value of comparison spectrum of Theta waves during spatial test period, at Fz position, found more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrum of Theta waves during spatial test at 0thminute or before drinking black tea showed no difference compared to doing spatial test after drinking black tea at 10th, 20thand 30thminute. Mean of spectrum of Theta waves during spatial test at 10th, 20thand 30thminute after drinking black tea ($\overline{X}$= 9.83, 12.06, 12.06, respectively) was not different significantly from spectrum of Theta waves before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 10.58). Mean of spectrum of Theta waves during spatial test at 20thand 30thminute after drinking black tea ($\overline{X}$=12.06, 12.06, respectively) was not different significantly from spectrum of Theta waves during spatial test after drinking black tea at 10thminute ($\overline{X}$= 9.83). Mean of spectrum of Theta waves during spatial test at 30thminute after drinking black tea ($\overline{X}$= 12.06) was not different

significantly from spectrum of Theta wave during spatial test after drinking black tea at 20^{th}minute ($\overline{X}$=12.06).

3. The changing frequency of Theta waves during spatial test at Cz position

Regarding to frequency of Theta waves during spatial test, p-value of frequency of Theta waves during spatial test period at Cz position were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of Theta waves during spatial test at 0^{th}minutes or before drinking black tea showed no difference compared to doing spatial test after drinking black tea at 10^{th}, $20^{th}$and 30^{th}minute. Mean of frequency of Theta waves during spatial test at 10^{th}, $20^{th}$and 30^{th}minutes after drinking black tea ($\overline{X}$= 5.33, 5.33, 5.43, respectively) was not different significantly from frequency of Theta waves in doing spatial test before drinking black tea at 0^{th}minute ($\overline{X}$= 5.41). Mean of frequency of Theta waves during spatial test at $20^{th}$and 30^{th}minute after drinking black tea ($\overline{X}$= 5.33, 5.34, respectively) was not different significantly from frequency of Theta waves during spatial test after drinking black tea at 10^{th} minute ($\overline{X}$= 5.33). Mean of frequency of Theta waves during spatial test at 30^{th} minutes after drinking black tea ($\overline{X}$= 5.34) was not different significantly from frequency of Theta waves during spatial test at 20^{th}minutes after drinking black tea ($\overline{X}$= 5.33). The results are shown in table 4.25

Table 4.25 Frequency of Theta waves during spatial test at Cz position

Theta wave during spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0^{th} minute	19	5.41	0.79	0.28	0.780
Spatial test at 10^{th} minute	19	5.33	0.84		
Spatial test at 0^{th}minute	19	5.41	0.79	0.38	0.707
Spatial test at 20^{th} minute	19	5.33	0.73		
Spatial test at 0^{th}minute	19	5.41	0.79	-0.10	0.922
Spatial test at 30^{th}minute	19	5.43	0.91		

Table 4.25 (continued)

Theta wave during spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 10th minute	19	5.33	0.84	0.00	1.000
Spatial test at 20th minute	19	5.33	0.73		
Spatial test at 10th minute	19	5.33	0.84	-0.52	0.607
Spatial test at 30thminute	19	5.43	0.91		
Spatial test at 20th minute	19	5.33	0.73	-0.44	0.665
Spatial test at 30thminute	19	5.43	0.91		

4. The changing spectrum of Theta waves during spatial test at Cz position

Table 4.26 Table shows spectrum of Theta waves during spatial test at Cz position

Spectrum of Theta wave During spatial test at Cz	n	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	7.50	4.72	0.53	0.606
Spatial test at 10th minute	19	6.77	2.72		
Spatial test at 0thminute	19	7.50	4.72	0.52	0.607
Spatial test at 20th minute	19	6.77	2.88		
Spatial test at 0thminute	19	7.50	4.72	0.40	0.694
Spatial test at 30thminute	19	6.96	2.36		
Spatial test at 10th minute	19	6.77	2.72	0.01	0.993
Spatial test at 20th minute	19	6.77	2.88		
Spatial test at 10th minute	19	6.77	2.72	-0.38	0.708
Spatial test at 30thminute	19	6.96	2.36		
Spatial test at 20th minute	19	6.77	2.88	-0.39	0.702
Spatial test at 30thminute	19	6.96	2.36		

According to data in table 4.26, p-value of spectrum of Theta waves during spatial test period at Cz position were found more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Spectrum of Theta waves during spatial test at 0^{th}minute or before drinking black tea showed no difference compared to doing spatial test after drinking black tea at 10^{th}, $20^{th}$and 30^{th}minute. Mean of spectrum of Theta waves during spatial test at 10^{th}, $20^{th}$and 30^{th}minutes after drinking black tea ($\overline{X}$= 6.77, 6.77, 6.96, respectively) was not different significantly from spectrum of Theta waves during spatial test before drinking black tea at 0^{th}minute ($\overline{X}$= 7.50). Mean of spectrum of Theta waves during spatial test at $20^{th}$and 30^{th}minutes after drinking black tea ($\overline{X}$= 6.77, 6.96, respectively) was not different significantly from spectrum of Theta waves during spatial test drinking black tea at 10^{th}minutes ($\overline{X}$= 6.77). Mean of spectrum of Theta waves during spatial test at 30^{th}minutes after drinking black tea ($\overline{X}$= 6.96) was not different significantly from spectrum of Theta waves during spatial test after drinking black tea at 20^{th}minutes ($\overline{X}$= 6.77).

4.2.5 The changing frequency and spectrum of Delta waves

This kind of frequency is specific only to frequencies range 0.5 - 3 Hz or Delta wave range. The result was collected from frequency 0.5 - 3 Hz. The analysis of data is to compare frequency and spectrum of Delta wave that change in the time of eyes closed, eyes open before to after drinking black tea, frequency and spectrum of Delta waves that change during spatial test at 0^{th}, 10^{th}, $20^{th}$and 30^{th}minute. The data was analysed by pair-t-test, significant at p-value <0.05.

4.2.5.1 The changing of Delta wave in period of eyes closed

The result of this part is to find frequency and spectrum of Delta waves in eyes closed period before drinking black compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme. The comparison data was analysed by pair-t-test and shown as in the table 4.27.

Table 4.27 Frequency and spectrum of Delta waves during eyes closed period

Frequency and Spectrum of Delta wave during eye close	**N**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	2.91	0.71	-0.23	0.819
Frequency After drinking at Fz	19	2.95	0.76		
Spectrum Before drinking at Fz	19	8.41	5.35	0.02	0.988
Spectrum After drinking at Fz	19	8.39	4.88		
Frequency Before drinking at Cz	19	2.80	0.65	-0.65	0.522
Frequency After drinking at Cz	19	2.94	0.72		
Spectrum Before drinking at Cz	19	7.18	4.02	1.60	0.126
Spectrum After drinking at Cz	19	6.22	2.61		

According to data in table 4.27, p-value of frequency and spectrum of Delta waves during eyes closed period, at Fz and Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of Delta waves, at Fz and Cz position, during eyes closed were not significantly increased between before and after drinking black tea. Mean of frequency of Delta waves during eyes closed period at Fz and Cz after drinking black tea ($\overline{X}$= 2.95 and 2.94, respectively) were not increased significantly from frequency before drinking black tea ($\overline{X}$= 2.91 and 2.80 respectively). Spectrum of Delta waves, at Fz and Cz position, during eyes closed were not significantly decreased between, before, and after drinking black tea. Mean of spectrum of Delta waves during eyes closed period at Fz and Cz after drinking black tea ($\overline{X}$= 8.39 and 6.22, respectively) was not significantly decreased from spectrum before drinking black tea ($\overline{X}$= 8.41 and 7.18, respectively).

4.2.5.2 The changing of Detawave during eyes open period

The result of this part is to find frequency and spectrum of Delta waves in eyes open period before drinking black tea compared to after drinking black tea by Brain Actor. All data was computed by mind mirror programme. The comparison data was analysed by pair-t-test and shown as in the table 4.28

Table 4.28 Table shows frequency and spectrum of Delta waves during eyes open period

Frequency and Spectrum of Delta wave during eyes open	**n**	$\overline{X}$	**SD**	**t**	***p***
Frequency Before drinking at Fz	19	2.71	0.72	-0.60	0.556
Frequency After drinking at Fz	19	2.82	0.77		
Spectrum Before drinking at Fz	19	9.40	5.13	1.17	0.257
Spectrum After drinking at Fz	19	8.41	4.32		
Frequency Before drinking at Cz	19	2.90	0.59	0.84	0.410
Frequency After drinking at Cz	19	2.75	0.61		
Spectrum Before drinking at Cz	19	6.77	4.17	1.91	0.073
Spectrum After drinking at Cz	19	5.59	2.25		

According to data in table 4.28, p-value of both frequency and spectrum of Delta waves during eyes open period, at Fz and Cz position, were more than significant level 0.05. Null hypothesis (H_0) cannot be accepted. Frequency of Delta waves during eyes open after period was not increase significantly between before and after drinking black tea. Mean of frequency of Delta waves during eyes open period at Fz after drinking black tea ($\overline{X}$= 2.82) was not significantly increased from frequency before drinking black tea ($\overline{X}$= 2.71). Spectum of Delta waves at Fz and frequency and spectrum of Delta waves at Cz position during eyes open after period was not decreased significantly before drinking black tea. Mean of spectrum of Delta waves at Fz position and frequency and spectrum of Delta wave at Cz position during eyes open period after drinking black tea ($\overline{X}$= 8.41, 2.75 and 5.59, respectively) was not decreased significantly from spectrum at Fz, frequency and spectrum at Cz before drinking black tea ($\overline{X}$= 9.40, 2.90 and 6.77, respectively)

4.2.5.3 The changing frequency and spectrum of Delta waves during spatial test at Fz at Cz postion

The result of this part is to find frequency and spectrum of delta waves on screen of Brain Actor during spatial test at the time 0 minute and doing spatial test with drinking black tea at the time 10, 20 and 30 minutes. Delta waves on screen of Brain Actor was computed by mind mirror programme. All data was analysed by pair-t-test, significant level is 0.05

1. The changing frequency of Delta waves during spatial test at Fz position

Table 4.29 Frequency of Delta waves during spatial test at Fz position

Frequency of Delta wave During spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	3.09	0.64	1.20	0.247
Spatial test at 10th minute	19	2.91	0.79		
Spatial test at 0thminute	19	3.09	0.64	1.46	0.161
Spatial test at 20th minute	19	2.89	0.59		
Spatial test at 0thminute	19	3.09	0.64	2.64	0.017*
Spatial test at 30thminute	19	2.55	0.77		
Spatial test at 10th minute	19	2.91	0.79	0.15	0.886
Spatial test at 20th minute	19	2.89	0.59		
Spatial test at 10th minute	19	2.91	0.79	1.65	0.116
Spatial test at 30thminute	19	2.55	0.77		
Spatial test at 20th minute	19	2.89	0.59	2.19	0.042*
Spatial test at 30thminute	19	2.55	0.77		

Note. * $p < .05$

According to data in table 4.29, p-value of frequency of Delta waves during spatial test period, at Fz position, were less than significant level 0.05 between 0^{th} and 30^{th}minute, $20^{th}$and 30^{th}minute. Null hypothesis (H_0) can be accepted. Frequency of Delta waves during spatial test at 0^{th}minute or before drinking black tea showed significant decrease from doing spatial test after drinking black tea at 30^{th}minute. Besides, frequency of Delta waves during spatial test at 30^{th} minute after drinking black tea also showed significant decrease from 20^{th} minute. Mean of frequency of Delta waves during spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 2.55) showed significant decrease from frequency of Delta waves at 20^{th}minute after drinking black tea and at 0^{th} minute ($\overline{X}$= 2.89 and 3.09, respectively); nevertheless, p-value of frequency of Delta waves during spatial test at 0^{th} or before drinking black tea and after drinking black tea at10^{th}, 20^{th} minute showed no significant difference; moreover, frequency of Delta waves after drinking black tea at 10^{th} also showed no significant change in 20^{th} and 30^{th} minute. Mean of frequency of Delta waves during spatial test at 10^{th} and 20^{th}after drinking black tea ($\overline{X}$= 2.91, 2.89, respectively) was not different significantly from spatial test before drinking black tea at 0^{th}minute ($\overline{X}$= 3.09). Mean of frequency of Delta waves during spatial test at $20^{th}$and 30^{th} minutes after drinking black tea ($\overline{X}$= 2.89, 2.55, respectively) was not different significantly from frequency of Delta wavess after drinking black tea at 10^{th}minute ($\overline{X}$= 2.91).

2. The changing spectrum of Delta waves during spatial test at Fz position

Regarding to spectrum of Delta waves during doing spatial test at Fz position, p-value of Delta waves during spatial test period, at Fz position, were more than significant level 0.05 between 20^{th} and 30^{th} minute. Null hypothesis (H_0) can be accepted. Spectrum of Delta waves during spatial test at 30^{th}minute after drinking black tea showed significant increase from 20^{th} minute. Mean of spectrum of Delta waves in doing spatial test at 30^{th}minute after drinking black tea ($\overline{X}$= 13.62, respectively) was not different significantly from doing spatial test after drinking black tea at 20^{th}minute ($\overline{X}$= 11.93); however, p-value of spectrum of Delta waves during spatial test at 0^{th}, $20^{th}$and 30^{th} minute showed more than significant level 0.05 compared to spectrum of delta waves at 0^{th} minute. This means Null hypothesis (H_0) cannot be accepted. Mean of spectrum of Delta waves during spatial test at $20^{th}$and 30^{th}minute after drinking black tea ($\overline{X}$= 11.93 and

13.62, respectively) was not significantly decreased before doing spatial test drinking black tea at 0thminute ($\overline{X}$= 10.06); nevertheless, mean of spectrum of Delta waves during spatial test at 10thminute after drinking black tea ($\overline{X}$= 9.76) was not significantly decreased in doing spatial test before drinking black tea at 0thminute ($\overline{X}$= 10.06). Moreover, p-value of spectrum of Delta waves during spatial test after drinking black tea at 20th, 30th compared to 10th minute were more than significant level 0.05. This means null hypothesis (H_0) can be accepted. Spectrum of delta waves during spatial test at 20thminute after drinking black tea showed no significant increase after drinking black tea at 30thminute. Mean of spectrum of delta waves of doing spatial test at 30thminute after drinking black tea ($\overline{X}$= 13.62) was not significantly decreased for delta waves after doing spatial test after drinking black tea at 20thminute ($\overline{X}$= 11.93). The results are shown in table 4.30.

Table 4.30 Spectrum of Delta wave during spatial test at Fz position

Spectrum of Delta wave During spatial test at Fz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	10.06	6.44	0.17	0.871
Spatial test at 10th minute	19	9.76	5.20		
Spatial test at 0thminute	19	10.06	6.44	-0.61	0.547
Spatial test at 20th minute	19	11.93	13.58		
Spatial test at 0thminute	19	10.06	6.44	-1.02	0.320
Spatial test at 30thminute	19	13.62	15.56		
Spatial test at 10th minute	19	9.76	5.20	-0.84	0.411
Spatial test at 20th minute	19	11.93	13.58		
Spatial test at 10th minute	19	9.76	5.20	-1.28	0.215
Spatial test at 30thminute	19	13.62	15.56		
Spatial test at 20th minute	19	11.93	13.58	-2.41	*0.027
Spatial test at 30thminute	19	13.62	15.56		

3. The changing frequency of Delta waves during spatial test at Cz position

Table 4.31 Frequency of Delta waves during spatial test at Cz position

Frequency of Delta wave during spatial test at Cz	**n**	$\overline{X}$	**SD**	**t**	***p***
Spatial test at 0th minute	19	2.96	0.49	-1.94	0.068
Spatial test at 10th minute	19	3.20	0.50		
Spatial test at 0thminute	19	2.96	0.49	-0.18	0.858
Spatial test at 20th minute	19	2.99	0.40		
Spatial test at 0thminute	19	2.96	0.49	1.19	0.251
Spatial test at 30thminute	19	2.79	0.68		
Spatial test at 10th minute	19	3.20	0.50	1.31	0.206
Spatial test at 20th minute	19	2.99	0.40		
Spatial test at 10th minute	19	3.20	0.50	2.47	*0.024
Spatial test at 30thminute	19	2.79	0.68		
Spatial test at 20th minute	19	2.99	0.40	1.14	0.267
Spatial test at 30thminute	19	2.79	0.68		

According to data in table 4.31, p-value of frequency of Delta waves during spatial test period, at Cz position, was more than significant level 0.05 between 20th and 30th minute. Null hypothesis (H_0) can be accepted. Frequency of Delta waves during spatial test at 20thminute after drinking black tea showed significant decrease from doing spatial test after drinking black tea at 30thminute. Mean of frequency of Delta waves during spatial test at 30th, after drinking black tea ($\overline{X}$=2.79) was decreased significantly from frequency of Delta waves during spatial test after drinking black tea at 20th minute ($\overline{X}$= 2.99); however, p-value of the comparison frequency of Delta waves during spatial test period, at Cz position, was more than significant level 0.05 between 0th to 10th, 20th and 30th minute and between 10th to 20th and 30th minute. Null hypothesis (H_0) cannot be accepted. Mean of frequency of Delta waves during spatial test at 10thand

20^{th} minute after drinking black tea ($\overline{X}$= 3.20 and 2.99, respectively) were not increased significantly from frequency before drinking black tea at 0^{th}minute ($\overline{X}$= 2.96); however, mean of frequency of Delta waves during spatial test at 30^{th} minute after drinking black tea ($\overline{X}$= 2.79) was not decreased significantly from frequency before drinking black tea at 0^{th}minute ($\overline{X}$= 2.96). Moreover, frequency of Delta waved at 20^{th} and 30^{th} minute after drinking black tea were not siginificantly decreased from frequency after drinking black tea at 10^{th} minute. Mean of frequency of Delta waved during doing spatial test at 20^{th} and 30^{th}minute after drinking black tea ($\overline{X}$= 2.99 and 2.79, respectively) was not decreased significantly from frequency of Delta waves during spatial test after drinking black tea at 10^{th}minute ($\overline{X}$= 3.20).

4. The changing spectrum of Delta wave during doing spatial test at Cz position

Regarding to spectrum of Delta waves during spatial test at Cz position, p-value of spectrum of Delta waves during spatial test period were more than significant level 0.05. This means null hypothesis (H_0) cannot be accepted. Spectrum of Deltas wave during spatial test at 0^{th} minutes or before drinking black tea showed no different compared to doing spatial test after drinking black tea at 10^{th}, $20^{th}$and 30^{th}minutes. Mean of spectrum of Delta waves in doing spatial test at 10^{th}, 20^{th} and 30^{th}minute after drinking black tea ($\overline{X}$= 6.63, 6.25, 7.13, respectively) was not different significantly from spectrum of Delta waves during spatial test after drinking black tea at 0^{th} minute ($\overline{X}$= 7.21). Mean of spectrum of Delta waves during spatial test at $20^{th}$and 30^{th} minutes after drinking black tea ($\overline{X}$= 6.25 and 7.13, respectively) was not different significantly from spectrum of Delta waves after drinking black tea at 10^{th}minute ($\overline{X}$= 6.63). The results are shown in table 4.32

Table 4.32 Spectrum of Delta wave during doing spatial test at Cz position

Spectrum of Delta wave during spatial test at Cz	N	$\overline{X}$	SD	t	*p*
Spatial test at 0th minute	19	7.21	3.92	0.45	0.658
Spatial test at 10th minute	19	6.63	3.90		
Spatial test at 0thminute	19	7.21	3.92	0.91	0.374
Spatial test at 20th minute	19	6.25	2.45		
Spatial test at 0thminute	19	7.21	3.92	0.08	0.940
Spatial test at 30thminute	19	7.13	3.19		
Spatial test at 10th minute	19	6.63	3.90	0.49	0.633
Spatial test at 20th minute	19	6.25	2.45		
Spatial test at 10th minute	19	6.63	3.90	-0.51	0.617
Spatial test at 30thminute	19	7.13	3.19		
Spatial test at 20th minute	19	6.25	2.45	-1.86	0.080
Spatial test at 30thminute	19	7.13	3.19		

According to data in table 4.33, p-value of the comparison of spectrum of Delta waves during patial test period at Cz position were found more than significant level 0.05. This means null hypothesis (H_0) cannot be accepted. Spectrum of Delta waves during spatial test at 0thminute or before drinking black tea showed no significant decrease compared to doing spatial test after drinking black tea at 10th, 20th and 30thminute. Mean of spectrum of Delta waves in doing spatial test at 10th, 20thand 30thminute after drinking black tea ($\overline{X}$= 6.63, 6.25, 7.13, respectively) was not decreased significantly from spectrum of Delta waves in doing spatial test before drinking black tea at 0thminute ($\overline{X}$= 7.21). Spectrum of Delta waves during spatial test at 20th minute after drinking black tea showed no significantly decreased to doing spatial test after drinking black tea at 10th minute. Mean of spectrum of Delta waves during spatial test at 20thminute after drinking black tea ($\overline{X}$= 6.25) was not decreased significantly from spectrum of Delta waves during spatial test before drinking black tea at 10thminute ($\overline{X}$= 6.63). Spectrum of Delta waves during spatial test at 30th minute after drinking black tea showed no significantly increased to doing spatial test after drinking black tea at 10thand

20^{th}minute. Mean of spectrum of Delta waves of doing spatial test at 30^{th}minute after drinking black tea ($\bar{X}$= 7.13) was not increased significantly from spectrum of Delta waves during spatial test after drinking black tea at 10^{th} and 20^{th}minute ($\bar{X}$= 6.63 and 6.25, respectively).

4.3 Result to Prove Hypotheses

4.3.1 Attentive increase in cumulative drnking black tea.

According to data of reaction time and numbers of correct answers, attentive process in cumulative drinking black tea could increase significantly after drinking black tea 10^{th}, 20^{th} and 30^{th} minutes at p-value <0.05. On the other hand, the numbers of correct answers could increase only after drinking black tea 10 and 20 minutes. The number of correct answers decreased significantly after 30 minute of drinking at p-value<0.05. Also, numbers of correct answers showed significant decrease after drinking black tea 20 and 30 minutes. This result could prove that attentive process in cumulative drinking of black tea could improve only reaction time not numbers of correct answers at p-value <0.05.

4.3.2 The changing of frequency and spectrum of brainwaves.

This study has studied 5 frequency bands, non specific frequency (64 Hz), beta (13 – 30 Hz), alpha (8 – 12 Hz), theta (4 – 7 Hz) and delta (0.5 – 3 Hz). Each frequency band showed results to prove hypothesis as followed.

In non screening frequency band, there was no significantly change of frequency and spectrum of any brainwave in both Fz and Cz position. According to mean of frequency in Fz position, theta wave frequency was the dominant frequency. Regarding to Cz position, theta wave was also the dominant frequency

Beta wave frequency, in this frequency band, there was no significant change in frequency or spectrum of betawave. However, frequency of beta wave showed siginificant increase only between eyes closed period before drinking black tea to after drinking at p-value <0.05. This effect has shown only at Fz position

Alpha wave frequency; in this frequency band, there was significant increase of frequency of alpha waves from 0^{th} minute to 10^{th} minute; nevertheless, frequency of alpha

waves was significantly decreased after 10^{th} minute at Fz position at p-value <0.05. Moreover, the spectrum of alpha wave was also increased significantly from 10^{th} minute to 30^{th} minute after drinking black tea at p-value <0.05

Theta wave frequency; in this frequency band, there was significantly increase spectrum of theta wave from eyes closed before drinking black tea compared to after drinking at p-value <0.05. This effect occured at Cz position

Delta wave frequency; in this frequency band, there was a siginificant increase spectrum of delta waves from 0^{th} minute to 30^{th} minute and from 20^{th} minute to 30^{th} minute at p-value <0.05. This effect occurred at Fz position. However, frequency of delta waves was also decreased at 10^{th} minute to 30^{th} minute at p-value <0.05 in Cz position.

In conclusion, alpha waves in cumulative drinking black tea was increased after drinking black tea 10 minutes ($p<0.05$). Delta waves was increased 30 minutes after drinking black tea ($p<0.05$)

CHAPTER 5

CONCLUSION, DISCUSSION AND SUGGESTION

5.1 Conclusion

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. In order to prove the hypotheses, 20 urban working people (12 females and 8 males) were participated in this study. One participant excluded from this study. The age of participants ranged 25 – 55 years old. Most of occupations were health care area. Brainwaves were recoded by Brain Actor 2 channels EEG and computed by LearnMon programme version 1.72 (Geiser & Stoeffler, 1999). The attentive process was measured by using the Spatial Relationship sub-test of the Mechanical Aptitude and Spatial Relationships Tests (Joan & Norman, 2004) The data of brainwave and attention was analysed by pair-t-test and significant at p-value < 0.05.

The analysis of brainwave was done on 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. The data from eyes closed and eyes open before and after drinking black tea and during doing spatial test were analysed by pair-t-test.

Regarding to 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 wave 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 wave frequency, the frequency of alpha wave showed significant change between during spatial test at 10^{th}, 20^{th} and 30^{th} minute after drinking black tea. The frequency of alpha waves at Fz position was increase at 10^{th} minute and decrease a bit at 20^{th} minute. Finally, it increased again at 30^{th} minute after drinking black tea. Nevertheless, spectrum of alpha at Fz position wave showed a decreased significantly at 30^{th} after drinking black tea when compared from 10^{th} minute after drinking black tea ($p<0.05$)

Regarding to data in theta wave frequency, the theta waves 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 wave, frequency of delta wave at Fz position showed decrease at 30^{th} minute ($p<0.05$); nevertheless, spectrum of delta waves showed increase, significantly, at Fz position also ($p<0.05$). Moreover, frequency of delta waves also showed significant decrease at 30^{th} minute when compared to 10^{th} minute after drinking black tea ($p<0.05$).

5.2 Discussion

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 wave, Alpha wave and Delta wave were shown during spatial test after drinking black tea.

Interestingly, frequency of alpha waves along cumulative drinking of black tea was shown significantly since the 10^{th} minute; however, spectrum of the alpha wave changed significantly after drinking black tea, after 30^{th} 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 wave benefits corresponded to memory storage and processing (Bravermann et al., 2012). Alpha waves are still associated with alertness and peacefulness (Sittiprapaporn, 2013; Huang & Charyton, 2008). Alpha waves 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 waves 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 waves 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 waves 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 wave. Delta waves 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 30^{th} minute after drinking black tea both frequency and spectrum at Fz position. It could be assumed that the solving of spatial test at 30^{th} minute after drinking black tea was more complex than 10^{th} or 20^{th} minute; otherwise, cumulative drinking black tea could present the effect from 30^{th} minute after drinking black tea.

In conclusion, cumulative drinking of black tea could help promote alpha waves which help relaxing and attention. This could promote longevity for brain health in the term of improving attention with no stress.

5.3 Suggestions

To our knowledge, this paper is the first reported study of brainwaves by influenced by black tea and studied attention, in cumulative drinking of black tea. 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.

5.3.1 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 ingredients. This could help us to explain more specific effects of black tea on brainwaves and attention.

5.3.2 In order to expand the explanation of brainwaves affected by black tea, all of the participants in this study were urban people. The study should study rural people who may have an easy lifestyle. This could help us to under stand more effects of black tea.

5.3.3 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 equipments in order to find more effects to brainwaves of black tea on other sides of the brain.

5.3.4 Interestingly, spectrum of betawaves and theta waves 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.

5.3.5 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.

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APPENDIX

APPENDIX

INFORMED CONSENT FORM

หนังสือยินยอมเข้าร่วมโครงการวิจัย (Informed Consent Form)

วันที่.....เดือน..... พ.ศ.....

ข้าพเจ้า (นาย/นาง/นางสาว)..... อายุ.....ปี อยู่บ้านเลขที่..... หมู่ที่.....ถนน.....ตำบล..... อำเภอ.....จังหวัด..... รหัสไปรษณีย์.....

ขอทำหนังสือแสดงความยินยอมเข้าร่วมโครงการวิจัยเพื่อเป็นหลักฐานแสดงว่า

1. ข้าพเจ้ายินยอมเข้าร่วมโครงการวิจัยของ นาย เอกสิทธิ์ ลลิตสุรเดชเรื่อง “การศึกษาผลของการดื่มชาดำแบบสะสมต่อระดับความสนใจ ด้วยความสมัครใจ โดยมิได้มีการบังคับ หลอกลวงแต่ประการใด และพร้อมจะให้ความร่วมมือในการวิจัย

2. ข้าพเจ้าได้รับการอธิบายและตอบข้อสงสัยจากผู้วิจัยเกี่ยวกับวัตถุประสงค์การวิจัย วิธีการวิจัย ความปลอดภัย อาการ หรืออันตรายที่อาจเกิดขึ้น รวมทั้งประโยชน์ที่จะได้รับจากการวิจัย โดยละเอียดแล้วตามเอกสารชี้แจงผู้เข้าร่วมการวิจัยแนบท้าย

3. ข้าพเจ้าได้รับการรับรองจากผู้วิจัยว่าจะเก็บข้อมูลส่วนตัวของข้าพเจ้าเป็นความลับ จะเปิดเผยได้เฉพาะในรูปแบบของการสรุปผลการวิจัยเท่านั้น

4. ข้าพเจ้าได้รับทราบจากผู้วิจัยแล้วว่า ผู้วิจัยยินดีจะรับผิดชอบค่ารักษาพยาบาล ที่เป็นผลสืบเนื่องจากอาการข้างเคียงจากผลิตภัณฑ์ที่ใช้ในการวิจัยนี้จนต้องเข้ารับการรักษาในโรงพยาบาลตามสมควร

5. ข้าพเจ้าได้รับทราบว่า ข้าพเจ้ามีสิทธิที่จะถอนตัวออกจากการวิจัยครั้งนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบใด ๆ ต่อการรักษาพยาบาลตามสิทธิ์ที่ข้าพเจ้าควรได้รับ

ข้าพเจ้าได้อ่านและเข้าใจข้อความตามหนังสือนี้แล้ว จึงได้ลงลายมือชื่อไว้เป็นสำคัญ พร้อมกับหัวหน้าโครงการวิจัยและพยาน

ลงชื่อ..... ผู้ยินยอม/ผู้ปกครอง

(.....)

ลงชื่อ..... หัวหน้าโครงการ

(นายเอกสิทธิ์ ลลิตสุรเดช)

ลงชื่อ..... พยาน

(.....)

ลงชื่อ..... พยาน

(.....)

ที่พิเศษ /2557 กลุ่มผลิตภัณฑ์ชาและส่งเสริมการท่องเที่ยวเชิงนิเวศน์
ศรีนาป่าน-ตาแวน ต.เรือง อ.เมืองน่าน จ.น่าน 55000

2 มิถุนายน 2557

เรื่อง สนับสนุนผลิตภัณฑ์ชางานวิจัย

เรียน คุณเอกสิทธิ์ ลลิตสุรเดช

ตามที่ คุณเอกสิทธิ์ ลลิตสุรเดช ได้ติดต่อมาที่กลุ่มผลิตภัณฑ์ชาและส่งเสริมการท่องเที่ยวเชิงนิเวศน์ ศรีนาป่าน-ตาแวน ต.เรือง อ.เมืองน่าน จ.น่าน ขอรับการสนับสนุนผลิตภัณฑ์ชา เพื่อทำงานวิจัยของนักศึกษามหาบัณฑิต สาขา วิทยาศาสตร์ชะลอวัยและฟื้นฟู มหาวิทยาลัยแม่ฟ้าหลวง เพื่อการศึกษาคลื่นสมองและความสนใจในการดื่มชาดำแบบสะสม

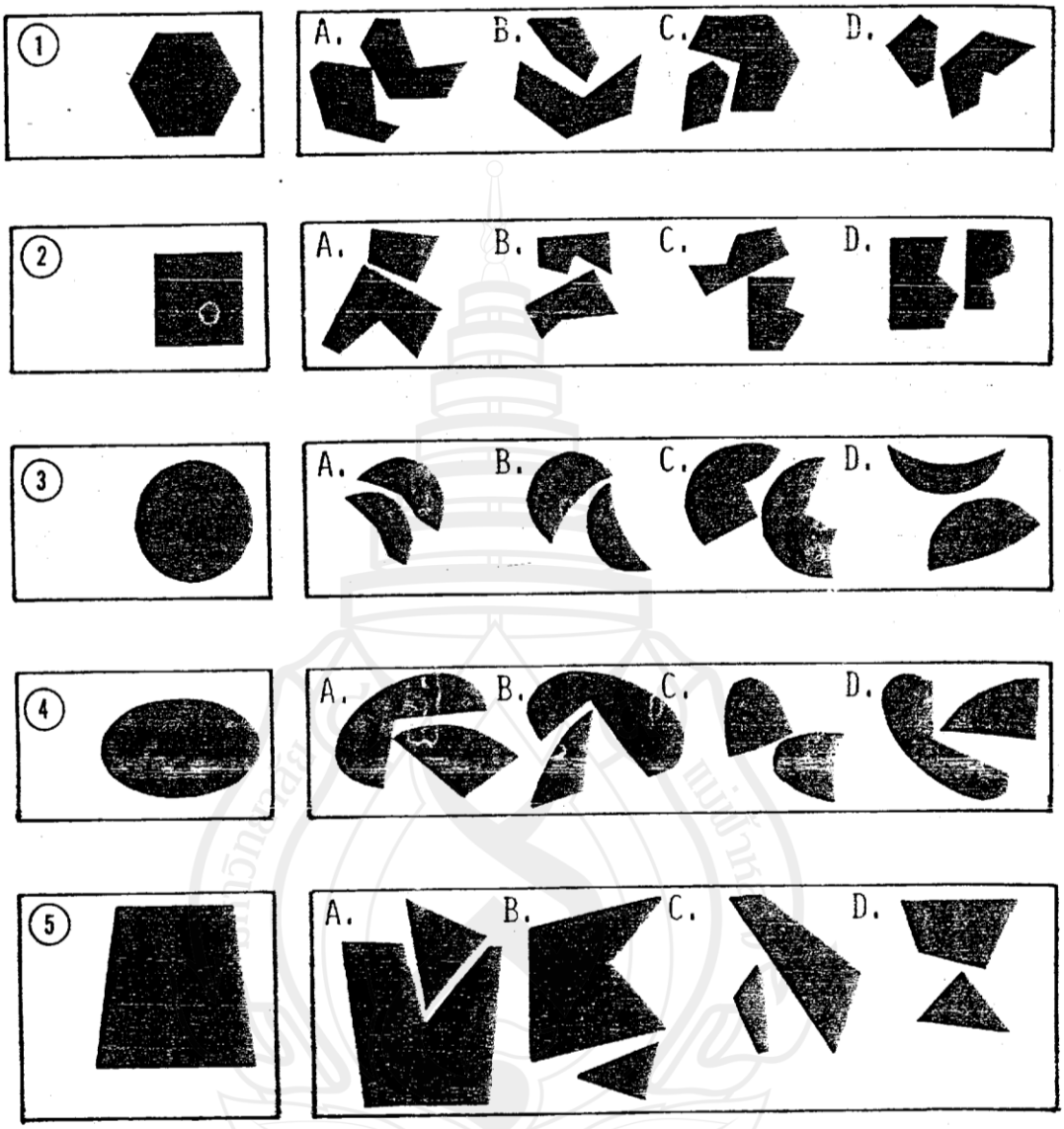
ทางกลุ่มฯ มีความยินดียิ่งและขอสนับสนุนผลิตภัณฑ์ชาของกลุ่มฯ เพื่อทำการวิจัยในครั้งนี้ และทางกลุ่มฯ หวังว่าเมื่องานวิจัยได้ข้อมูลเป็นประการใด ขอให้ทีมงานวิจัยช่วยส่งข้อมูลให้กับทางกลุ่มฯ ด้วยเพื่อจะเป็นประโยชน์กับคนที่รักษ์สุขภาพต่อไป และขอให้งานวิจัยจงสำเร็จทุกประการ

จึงเรียนมาเพื่อทราบ

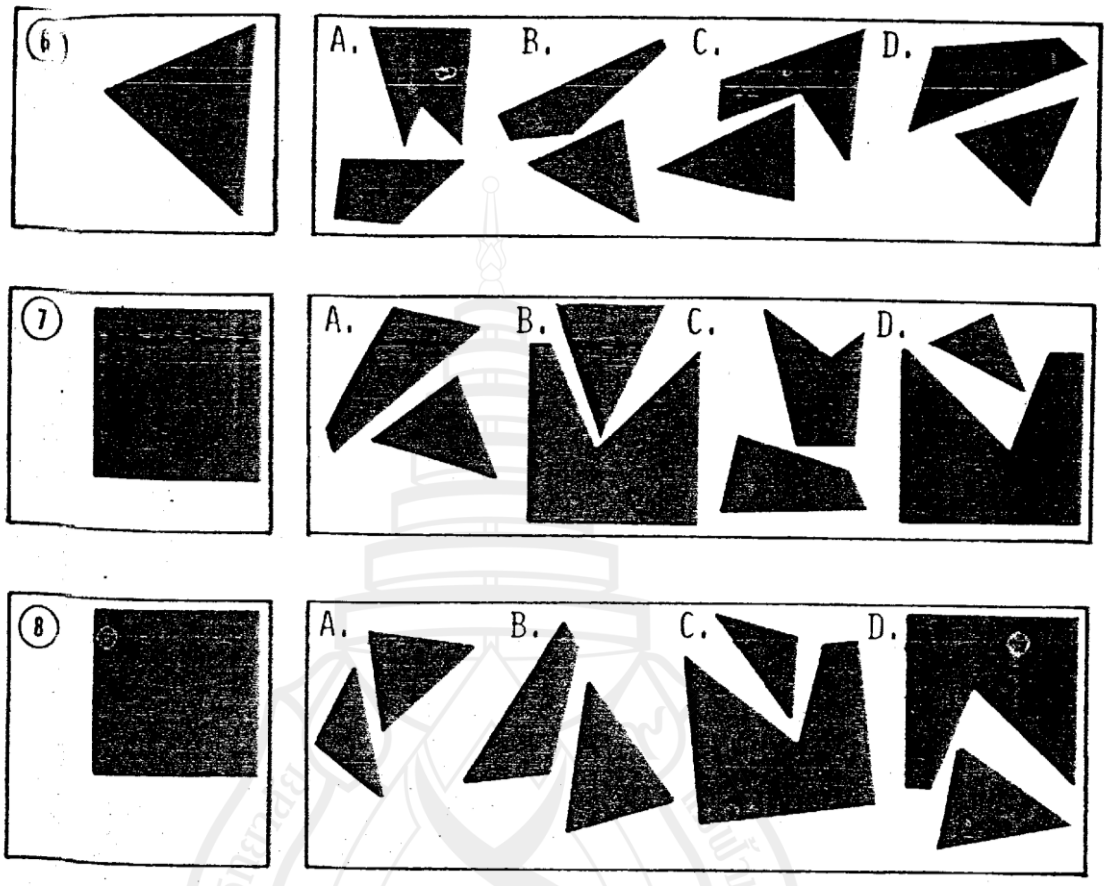
ขอแสดงความนับถือ

(นายบุญทวี ทะนันไชย)
ประธานกลุ่มผลิตภัณฑ์ชาและส่งเสริมการท่องเที่ยวเชิงนิเวศน์
ศรีนาป่าน-ตาแวน

Mechanical Aptitude and Spatial Relations Test



Mechanical Aptitude and Spatial Relations Test



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